UNITED STATES DEPARTMENT OF AGRICULTURE

FARM SECURITY ADMINISTRATION

DESIGN AND CONSTRUCTION

SOUTHEAST MISSOURI PROJECT

LA FORGE, MISSOURI

DISTRICT ENGINEER'S OFFICE

342 MASSACHUSETTS AVENUE

INDIANAPOLIS, INDIANA

SOUTHEAST MISSOURI REPORT

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FOREWORD

The design and construction of farmsteads, or the remodeling and rebuilding of the same, varies materially, depending on several conditions that are generally different for each job. It presents basic differences from the design and construction of urban dwellings.

The Department of Agriculture, through the Farm Security Administration, is engaged in assisting distressed farm families to secure farm homes. These families must earn sufficient income, through agriculture, to provide a secure living and also to repay to the Government, over a period of forty years, the low interest loan necessary to accomplish this.

There are three essential elements of a successful farm home. FIRST - Land of a quality and quantity sufficient to develop the essential agriculture income; SECOND - Working capital and equipment sufficient to properly operate this land; THIRD - Permanent structures and improvements necessary to properly house the farm family, their animals, equipment, and farm products.

The relations of these three basic elements of a successful farm home vary too widely to make any simple analysis possible. An analysis of the project farmsteads at the Southeast Missouri Project indicates that the relationship for this particular project approaches 40% for land; 20% for working capital and equipment; and 40% for fixed improvements.

The Chief Engineer's Office of the Farm Security Administration exists to assist the Administrator in the 40% of the development of a successful farm home, which is concerned with the fixed improvements necessary in each case.

The District Engineer of District Three is the Field Representative of the Chief Engineer and within his district, exists to assist the Regional Directors in this work.

The District Engineer of District Three was charged by the Chief Engineer and the Regional Director of Region Three, with the design and construction of one hundred and one farm homes at the Southeast Missouri Project; each unit to consist of a house, barn, privy, food storage, well and necessary fencing, for a sum under $2500.00 per farmstead.

These farmsteads were designed and built between the period of November 21st, 1937 and June 21st, 1938. They were built by force account operations, using the available relief

labor in the area.

Because of certain features of the engineering activities on this project, a very considerable interest has been evidenced in how this work was accomplished. The District Engineer has been directed to analyze and record these activities so that this record may be available for technical discussion and as a future reference source for technical men who may be called upon to consider similar technical problems on future governmental operations or private undertakings.

This report complies with these directions.

Edwin H. Crouch

EDWIN H. CROUCH

District Engineer

District Three.

INTRODUCTION

The problem at Southeast Missouri Project was simple and interesting. The Government had optioned, from banking interests, a tract of approximately 6700 acres of land situated near the set-back levy of the Mississippi River between New Madrid and Sikeston, Missouri. This land had been under cultivation for a number of years. Through various mishaps it had come under the absentee ownership of banking interests.

Approximately 100 families, 40% of them negroes, occupied shacks which were scattered about this tract of land. These people were employed, generally on a share-crop basis, to put the land into cultivation. In November of 1937, title to the land was about to pass to the Administration. The Regional Director of Region III was faced with the problem of developing this project in accordance with general plans which had formed the basis for acquiring it. A meeting was called which assembled at Sikeston, Missouri, on November 11, 1937, to consider the problem, outline the general plan, and start development work.

Mr. Milo Perkins, the Assistant Administrator of the Farm Security Administration, presided at the meeting. Mr. Raymond C. Smith, Regional Director, Region III, under whose direct supervision this project belonged; Mr. Philip Beck, his assistant in charge of development and management of projects within the region· and Mr. Hans Baasch, Mr. Beck's assistant in charge of this particular project, represented the Administration.

Mr. Perkins brought Captain Royal B. Lord, Corps of Engineers, United States Army, Chief Engineer of the Farm Security Administration, with him to the conference. The technical planning and construction work throughout the United States was under the direction of Captain Lord. Captain Lord directed Mr. E. H. Crouch, the engineer in charge of planning and construction activities in Region III, to attend, accompanied by certain engineers and architects of his staff.

As a result of the conference several solutions to the problem were determined: (The social, economic, and agricultural reasons for these decisions are covered in report articles by Mr. Philip Beck).

First - That the project would be developed in such a manner as to provide the equivalent of a 50-tillable-acre farm for each present resident of this area.

Second - That the land for each would cost approximately $2,500. in its present condition.

Third - That there should be designed, for each farm unit, a three-bedroom farm house, a barn, privy, well, food storage unit and farmyard fencing. In addition, necessary roads, drainage, and certain other project facilities, should also be built.

Fourth - The unit cost per farmstead was not to exceed $2,500. exclusive of general project structures, such as store, gin building, blacksmith shop, manager's quarters, etc.

Fifth - That operating loans, not to exceed $1,200., would be made to each farmer with which to purchase equipment and help in furnishing subsistence until first crops had been harvested.

Sixth - The Assistant Administrator, the Regional Director, and the Chief Engineer surveyed every possible source of funds. They determined that for construction $174,120 from funds on hand in the Missouri Rural Rehabilitation Corporation, the sum of $21,040 in the hands of the Regional Director, and approximately $40,000. worth of equipment, machinery and surplus materials left over after completing of other projects within the surrounding district would be made available for the project.

Farm plans were analyzed which showed that the client with a debt load of $6,200. could pay off within forty years (the amortization policy established by the Farm Security Administration). This plan and program, as outlined for a typical farm, is shown graphically in Plate I, and is analyzed in more detail by Mr. Beck in his report article.

PLATE I

With the approval of the Administrator, the funds and available facilities were placed at the disposal of Mr. Crouch by the Chief Engineer. Mr. Crouch was directed to proceed with the design of standard farmstead units conforming

to these general descriptive specifications and to construct and have one hundred farmsteads ready for occupancy prior to June 30, 1938.

Mr. Philip Beck was directed to proceed with the solution of the problems of organizing the project for operation, assigning clients to specific farms, settling the same, and having farms provided with the necessary equipment, supplies and management, to produce a 1938 crop. Mr. Beck's report article describes the solution of these problems; covers the methods employed to solve each problem; and gives the results that have been obtained to date.

This part of the report is concerned only with the technical features involved in the design and construction of the physical facilities.

PRELIMINARY DESIGN AND CONSTRUCTION ACTIVITIES

The District Engineer was familiar with the general conditions of the project area at Southeast Missouri. As technical advisor to the Regional Director of Region Three, he had spent considerable time on the project during the great floods of 1937, accompanied by the District Hydraulic Engineer, Mr. Paul Rossell, and the District Civil Engineer, Mr. Henry C. Cassell, determining the effect (on land of this project), of excessive flood water in the Mississippi River. Anticipating a future order for construction activities, he had used this opportunity to make a preliminary survey of the situation. Mr. Cassell and some of his assistants were even more familiar with the project, due to their civil engineering activities in connection with land acquisition work.

Mr. Crouch, accompanied by his three senior division chiefs; Mr. Rudolph Nedved, District Architect; Mr. Henry C. Cassell, District Civil Engineer and Mr. Charles E. Haywood, District Construction Engineer; conferred with Mr. P. G. Beck and his staff, concerning the general features to be considered in design and construction of this project. This was the first of several conferences. Mr. Beck included not only the project personnel present at the administrative and policy conferences, but also members of his staff charged with the development of plans, farm management, agriculture development, home management, cooperative and operating activities in these conferences.

The senior staff personnel, during the initial conference, made a complete tour of the project, visiting tentative farm unit locations; making studies of the roads and drainage; analyzing present and future farm building needs; and discussing the civil engineering and Soil Conservation reports concerning climatic and topographical conditions, effecting construction in this area. The tentative plans of the management personnel, concerning the standards of living conditions, sanitary facilities, farm activities, equipment, etc., and including such definite and typical items of mutual concern as the number of farmstead units, family selection statistics, size of house, barn, outbuildings, layout of farms as to crops, gardens, barn lots, farmstead plots, etc., were most carefully considered.

The District Engineer directed that each of his division heads

should spend some time in further detailed research on the ground and in conference with the technical heads of the Management Division to clarify, in their own minds, the physical, social, economic and agricultural aspects of the problems which would be essential for their guidance in the design and construction activities involved. He directed that a more detailed technical survey of the roads, railroad sidings, existing buildings, power, water and sanitary facilities available for construction activities be made. He directed that the group should assemble in his office at Indianapolis, prepared to go into the preliminary discussions, essential for determining direction and scope of planning; the selection and assignment of personnel; and the preparation of basic time and control schedules.

The District Engineer and his staff, in conference with Mr. P. H. Beck and his staff, assembled in the District Engineer's Office at Indianapolis late in November, for this more complete discussion and analysis of the problem, preparatory to the development of the essential designs and the determining of the development program. The District Engineer pointed out that it was the function of Mr. Beck and his staff to arrive at broad determinations of "WHAT" they desired to be done within the limits imposed by the general policy conference. That conference had definitely imposed certain limits of "WHEN" the work was to be performed. The function of the District Engineer and his staff, after securing and analyzing this data, was concerned with the "HOW" of technical design, and after approval, the building of structures conforming to these approved design plans.

The first problem taken up dealt with the cost ceiling of $2500. per farmstead unit. Considering the use demands of each structure within the farmstead unit, a preliminary budget was prepared.

1 - Well	$ 40.00
2 - Privy	60.00
3 - House	1300.00
4 - Barn	600.00
5 - Farmyard Fence & Access Rd.	100.00
6 - Food Storage	150.00
7 - Contingent	250.00
	$2500.00

The District Architect was directed to control the design of these structures, in conference with the Construction Engineer, so that each item could be built by force account methods within this budget.

The second major problem concerned the question of tract subdivision and layout. As a result of discussion, the District Engineer directed that the District Civil Engineer should complete the boundary survey and prepare immediately a tentative tract subdivision that would assist the farm management personnel in determining the size and location of farmstead units. He directed that all existing natural boundaries, railroads, levees, etc., would be utilized in this subdivision and that existing roads would be utilized so far as possible in determining farmstead location.

The Land Planning Engineers of the District Civil Engineer's Staff, and the on-site civil engineering personnel, would be faced with dual problem of completing this survey and subdivision work and of conditiening the roads sufficiently for construction purposes. It was directed that they would clear this activity sufficiently to enable them to undertake the location ef farmsteads and the staking out of building sites in advance of construction needs. Agreements were reached that the farm management personnel would cooperate in all of these activities. The District Engineer directed that as soon as time and personnel were available, studies would be undertaken, in conjunction with farm management personnel, to correct obvious drainage problems, so far as might be possible.

The third major problem considered the preliminary report of the labor situation, including an analysis of the availability of prospective homesteaders for construction labor. The Construction Engineer was directed to undertake more detailed investigations along this line immediately.

The fourth problem concerned the possibility of utilizing existing rail facilities, in the center of the project, for the establishment of a plant for construction purposes. The District Engineer pointed out that this might solve some of the problems that were apparent in this particular operation, such as the lack of skilled labor· the almost impassable conditions of some of the roads; and the expectancy of rainy weather that would interfere with construction activities. The District Engineer pointed out that certain features of the design activities would be determined by a decision regarding the method of field construction to be utilized.

The fift' problem considered was the quantity of new and repair work involved. The District Engineer directed that

the Construction Engineer, assisted by the District Architect, should make a careful survey of all existing buildings and determine which buildings, if any, were suitable for remodeling and repair. This was essential before a detailed schedule of quantities of structures could be worked out.

The sixth problem involved the study of the time limitations imposed by the policy personnel. As a result of this study it was decided that initial designs would be undertaken on or before December 1st, would be estimated for cost, and scheduled for discussion by the personnel involved on or about the 20th of December. The District Engineer directed that the farm management personnel should enter this discussion to study the use demands and how the design conformed to the general specifications that had been outlined by them. The construction personnel should enter this discussion from a standpoint of cost and engineering operations essential within the time limit. The Civil Engineering personnel would enter this discussion because of the necessity of their cooperation in working out coordinated time schedules for future operations.

These general directive decisions, having been reached, and definite instructions having been issued by the District Engineer, he then discussed the problem of personnel assignment. As a result of this discussion it was decided that only experienced personnel would be assigned to this operation. It was further decided that, due to the time element and the peculiar difficulties attendant upon these operations, this personnel should be most carefully selected. Personnel engaged in work within the district, which comprises twelve North Central States, were carefully considered.

The District Engineer directed that Mr. Nedved, District Architect, should assign the following personnel to this work. For the design of the house Mr. William Jones; for the design of the barn Mr. H. P. Twitchell; that Messrs. Richard Windisch and John G. Chapman would be detailed to assist in the preparation of plans. That the plan of the food storage would be left in abeyance, for the time being, until further investigation had been made on this subject by the District Architect and the Construction Engineer. That the question of preparing plans for repairing and remodeling of existing structures or of any special structures, such as store buildings, etc., would not be undertaken until after the basic design plans were at least in the approved form.

The District Engineer directed that Mr. Henry C. Cassell, District Civil Engineer, should assign Mr. Carney E. Wyrick

as Civil Engineer in charge of operations on this project, to remain on-site throughout the construction period; Mr. Albert Seeboth as Office Engineer, to remain only as long as needed; one experienced engineering field party and one engineering draftsman for on-site work throughout the construction period; additional field party, computing, and drafting personnel necessary during initial work.

Mr. Cassell was further directed to assign Mr. Stanley Brewster to this project as Land Planning Engineer, with such drafting assistants and field assistants as might be necessary. He was further directed that careful attention should be paid to the installation of proper water supply facilities and pumping equipment. He was directed to utilize the services of the District Hydraulic Engineer, Mr. Paul Rossell, for the purpose of making this survey; and, after it had been completed for advising on drainage problems incident to this work. The specific problem of designing a proper water supply system was directed to be assigned to Mr. Arthur Kinkade.

The District Engineer directed Mr. Chas. E. Haywood, District Construction Engineer, to assign Mr. Merlin S. Layton as Resident Construction Engineer. Mr. Layton was completing the construction of the Osage Farm Project Near Sedalia, Missouri. Mr. Arthur DeVriendt, who was completing work as Administrative Assistant to the Construction Engineer in charge of the Red River Farms Project, Fargo, North Dakota, was selected to be Mr. Layton's administrative assistant, or, Clerk of the Works. Mr. Richard Y. Kennard, of Mr. Haywood's estimating staff, was assigned as material estimator on Mr. Layton's staff. Mr. Frank Fisher, Resident Engineer Inspector, who had completed a tour of duty at the Red River Farms Project, Fargo, North Dakota, and was, at that time, on duty at the Greendale Farms Project near Milwaukee, Wisconsin, was assigned as Senior Resident Engineer Inspector. Mr. James Garland, having just completed work as Resident Engineer Inspector in Tennessee, was assigned as assistant to Mr. Fisher.

It was impossible to do more than outline a general program at this time. A careful analysis of the time element involved in these operations, was made, and a tentative program arrived at by working backward from the completion date of June 30th, 1938. The District Engineer directed that designs be started not later than December 1st, and be completed so that construction could be organized and reach a maximum production of two completed units per day by March 15, 1938.

Considerable discussion was devoted, at this time, to the obvious confusion that would occur, due to the improbability of certain functions of engineering work being completed prior to the commencing of other functions dependent upon their completion. So far as possible, these expected difficulties were anticipated, discussed, and provisions made for arriving at a detailed program and time schedule based upon designs, estimated and reduced to man, material and equipment hours, at the earliest possible date.

It was decided at this meeting that decisions concerning locations of on-site offices, warehouse facilities, facilitating plant establishment, etc., and decisions concerning needed equipment and supplies that would have to be moved to this project from other projects, would be reached at the earliest possible date. The necessity of close cooperation of all elements of the District Engineer's staff, in the initial stages of this operation, was pointed out and was recognized by all present. These general conditions having been disposed of, a more detailed discussion of the results of the on-site surveys and the conference with management personnel was entered into.

The first item concerned the condition of the existing structures. The houses were generally poorly constructed and inadequate for living conditions. The existing houses were small one-story buildings constructed on concrete pier bases. Girders and joists were not adequate for the loads; floors were single rough boards with open cracks; walls were of single board construction without studs; and the exterior was either vertical boards and battens or drop siding. Ceilings and roofs were sagging, and seldom weathertight. Porches were rotted and sagging with floor boards broken and missing. Windows and doors were broken, stuffed with rags and sacking, and without screens. These houses were of little value in an area where the bare necessity of living demanded that the house keep out wind, dust, rain, flies, snow and sleet. House plans were of one or two bedrooms with a kitchen. Some houses had only one room for both kitchen and sleeping service. It was impossible to repair these houses for use in a program of even minimum standards of decency and sanitation.

<u>PLATE 2</u>

The existing water supply consisted of open top pitcher pumps and shallow driven wells. There was no protection to prevent bacterial contamination. These wells were generally in farmyards for convenience or immediately adjacent rear doors of houses. New equipment and new wells were an obvious necessity, even in cases where existing building sites were used.

There existed various buildings that served the purpose of privies. These buildings could not be repaired; must be torn down and burned- and the privy pits filled in. The District Engineer directed that a sanitary privy with concrete base and riser designed by the Missouri State Board of Health and extensively built by W.P.A., would be used. Complete designs, lists of material, and the concrete riser and platform forms could be borrowed from the local W.P.A. office.

PLATE 3

There were very few salvageable outbuildings other than several barns. A few barns were in fairly good condition and could be remodeled. One large barn could be repaired for use of the farm manager. All outbuildings remodeled or repaired, would need new mud sills and regrading for proper drainage. Fencing was in a very bad state and in most cases should be completely replaced and rearranged to fit any farmyard plan.

PLATE 4

The cotton gin, warehouses and existing buildings connected with the gin would have to be repaired. It was questionable if the store could be repaired or remodeled as cheaply as a new structure could be built. No structure appeared suitable to be remodeled for a shop or project office.

The survey of existing roads indicated that all needed regrading, draining and surfacing. Several new stretches of roads must be built in order to get the best use of the land.

The District Engineer decided to move all necessary parties and facilities to the project site as soon as the preliminary sketch designs had been prepared, estimated, and analyzed, and discussed. He directed that a planning and construction office be set up on the gin property, for the purpose of completing preliminary and final plans and estimates, as soon after the Christmas Holidays as possible.

These preliminary detailed conferences, leading to the initial on-site operations and the preliminary design operations, fully occupied the time of the District Engineer and his staff during the remainder of 1937.

The District Civil Engineer started field work immediately following this executive conference. He pushed the completion

of the boundary survey; started correction and computation of the same for the registration of the land. He prepared tentative project maps to enable the development of subdivision plans. His land planning engineer was placed in immediate contact with the construction engineer on-site and the farm management personnel in order to make this preliminary subdivision as rapidly as possible. It was necessary that this type of work should proceed immediately and simultaneously in order to meet a strict construction schedule.

The District Engineer held a special conference with the District Architect and the personnel assigned to architectural and engineering design. He outlined to them a definite policy to guide them in the design of structures and engineering facilities (well and water supplies), for this project.

He directed that the first essential in the design of these farm homes at Southeast Missouri must be to provide a pure, adequate and satisfactory water supply, and safe and satisfactory sanitary arrangements for persons and animals.

Secondly, that all of the structures on these farm homes must be structurally sound. The forty year amortization plan made this a prime necessity. This was also an item of major importance to be considered in design, as recurring repairs and maintenance expenses were to be avoided.

The third element that should be carefully considered in the design of each structure on these farmsteads was to make them water-tight and fire-resistant. The security of living and success of farm operations were directly dependent on these important and vital factors.

The fourth element that should be considered in the design of structures for these farm homes, was to provide maximum utilities for each structure. The rigid restrictions of budget control made it especially important that for each unit of cost, the utmost value to the usability and comfort for the farm family and the maximum assistance to the agricultural operations, which would provide essential income, must be secured.

The fifth essential that was to be observed in the design of structures for these farm homes was to make them as attractive as possible. He pointed out that careful planning was necessary to secure attractive architecture and sensible arrangement of buildings, and that plans concerning painting

and landscaping of the buildings, should be considered. He pointed out that these items would add a little to the cost but would go far in making these homes more pleasant for living and working and that an attractive appearance of each farmstead would be a great asset to that community and a real factor in determining the value of the farm.

The District Engineer directed that within the limits imposed by the tentative budget to govern the design of each structure, if variations were necessary, they should be made in the order of importance established by these five major points controlling the design of a successful farm home.

CIVIL ENGINEERING

The basic data concerning this area of land had to be considered by the Civil Engineering personnel. The factual date contained in the report from the Soil Conservation Service, is therefore included in this first technical portion of the report.

The first work of the Civil Engineers was to prepare a boundary survey necessary for title clearance. As soon as options had been taken on the seventeen (17) original tracts composing the project of Southeast Missouri Farms surveys were instigated which formed the basis of all future planning of the project.

The first of these surveys was an individual land survey of each tract under option to determine any irregularities in title or number of acres described in the deed. The original deed description indicated a total of 6,744 acres, while planimeter data from field surveys indicated an approximate total of 6,795 acres. A final closed boundary survey was made to determine definitely the exact description, location, and area of these tracts. For a basis of comparison with the above figures, the final closed boundary survey indicated a total of approximately 6,720 acres.

One of the most important features of the preparation of boundary surveys for title clearance, was a study of the County survey records. The original land surveys of the area made a number of years ago, consequently valuable information concerning section, corners, boundaries, rights of way, etc. The examination of County Survey Records were made at the County Seat in New Madrid, New Madrid County, Missouri. Practically all of the section corners were obliterated or lost and had to be re-established from such information as was available in the County Records. Certain Railroad surveys were of great assistance in this work. When this information had been collected and the section corners re-established, it was possible to make a closed boundary survey according to the rules and regulations laid down by the United States Land Office.

This closed boundary survey was made with two objects in mind: FIRST - to provide an accurate closed survey for title investigation and deed description of acreage, etc.; and, SECONDLY - to correlate each tract survey with the surveys of adjacent tracts as a basis for future subdivision of the project into various economic units.

Engineers of the Soil Conservation Service made a complete survey of topography and soils to determine future land use. This survey furnished a physical as well as a chemical land inventory. The physical land inventory was indicated by a soil map of each tract which differentiated the individual soil types according to the system of classification used by the Bureau of Chemistry and Soils, and showed the approximate location and extent of each type.

The chemical tests indicated the relative amounts of various plant food elements that are available for plant production. These chemical tests, together with the known physical characteristics of each type, make it possible to interpret possible land use adaptations. These tests were conducted not only on the basis of surface types but also included the sub-soil types underlying each of the tracts.

This information was studied with the physical elevation of the areas and the known water table elevations, to assist in laying out the drainage system for the area. The copy of this report of the Soil Conservation Survey is available in the files of the Regional Director of Region III, Farm Security Administration, Indianapolis, Indiana.

The second major problem was to make a subdivision plan, essential before construction and operating planning for this project could be intelligently undertaken. This preliminary subdivision plan was drawn based on the tract boundary surveys and the Soil Conservation Survey. The various influences of the physical and chemical descriptions of the area including positions of roads, drainage ditches, swamps, Railroad, etc., were coordinated by the Land Planning Engineers and the preliminary subdivision was gradually evolved by cooperation with the Farm Management and Home Management Members of Mr. Beck's Staff.

The work of actual subdivision survey from final subdivision plans was carried out progressively in conjunction with the work of the Land Planning Engineers and the Construction Engineers, and was carefully coordinated to the original construction time schedule approved by the District Engineer.

Certain changes became necessary to the preliminary subdivision as the boundary survey coordinated the various tracts with each other and with the natural boundaries, roads, levees, drainage ditches, etc. These changes were incorporated in the final plans before unit boundaries

and corners could be definitely set. They involved slight adjustments of areas to conform to slight variations of soil and topography.

PLATE 5

The third item that the Civil Engineers were concerned with was the condition of the roads. In order to put these roads in shape for heavy use during the construction period, immediate action was necessary. The flat topography and poor drainage of the project area, made development dependent upon good roads. A road building and improvement program was carried out in conjunction with the County Road Commission and the Works Progress Administration. The County Road from the principal east and west graveled road connecting the project with Fahrenburg was relocated a half mile to the west along a ridge. The "Brush Prairie" road North of LaForge was relocated and completely rebuilt. Several fills were made across swampy areas which were impassable during wet seasons. Entrance roads were built to serve units not accessible otherwise and many of the others regraded and the ditches cleaned for better drainage.

The fourth major feature of the Civil Engineering activities was concerned with the drainage of the area. The area of the project forms part of the Southern extremity of what is known as the "Sikeston Ridge". The elevations vary from 290 feet to 310 feet above sea level with the average about 300 feet. The land surface is nearly level to slightly undulating, with many shallow depressions and small ridges varying from a few inches to ten feet in height appearing throughout and extending generally in a north and south direction. These differences in elevation, together with the textural differences of soils account for the wide variation in the drainage of the area.

PLATE 6

The Fahrenburg Levee, the third of a series extending inland from the Mississippi River, eliminates most of the possibility of floods from the river, although heavy rains during the spring season often inundates the lower areas. Since the fall or slope is to the southern areas and is much less in the lowlands than in the northern areas, the water does not flow out as rapidly as it enters and overflow is the result. Excess water occasionally stands on these low lying southern areas for days at a time, constituting a major health factor, besides ruining crops. The average annual precipitation is about forty-two inches which is fairly well distributed

throughout the year with the heaviest rainfall occurring in the spring and summer. The extent of the drainage problem is brought out by the fact that seventy percent of the land in Southeast Missouri is now within organized drainage districts.

The southern part of the project area lies in what is known as the "dog run" drainage ditch area, embracing approximately 1700 acres of land. This drainage district was organized in 1898. A main ditch was constructed from LaForge south to the Mississippi River. Several small laterals, which drain into the main ditch were constructed by private land-owners. These ditches had received little or no maintenance for a number of years and were partly filled with silt, blocked by brush, and did not function properly.

During construction a field survey was made of the drainage problem and plans were made to rejuvenate the old drainage system and to extend the main drainage ditch Northwest across the "Brush-Prairie" road through the Northwest portion of the project to "Noxhall Lane", the Northern boundary. Plans were also made for several laterals to drain pockets which had no outlets. The actual work of construction and repair on these ditches was started early in the spring of 1938. The existing swamp conditions were recognized by the State Board of Health as a serious threat to the health of the community and a "Malaria Control project was initiated to do this work under the Works Progress Administration. The Farm Security Administration furnished engineering survey plans and supervision of the work. All labor and incidental small tools would be furnished by the local W.P.A.

The brush was cleared out of the main ditch from LaForge south to the Mississippi River, the mud and silt removed, and the bottom of the ditch widened to eight feet. When the work on the main ditch was completed the laterals were cleaned and made serviceable. The extension of the main ditch to Noxhall Lane was commenced but was stopped by a court injunction obtained by the landowners living to the south of the project. This injunction stopped all further construction work on the ditches to prevent any more water than had been previously emptied into the main ditch from being drained down upon them. During the periods of high flood waters in the Mississippi River, the flood gates of the culvert through the levee which empties the water from the drainage ditches into the river are closed. Water coming down the ditch after the gates are closed forms a lake and spreads over the land next to the levee. There have

been several efforts to reorganize the whole drainage district and install pumps to lift this water over the levee during periods of flood, but these efforts have failed. The landowners near the levee, do not want the drainage system enlarged as it would mean that more of their land would be under water when the flood gates are closed.

PLATE 7

The fifth major Civil Engineering activity consisted of farmstead layouts. This work was carried out in very close cooperation with the Land Planning section of the Engineering Division. It involved many problems which are covered in the report of the activities of the Land Planning Engineers and are not repeated here.

As soon as all tract boundary surveys were completed and as computations of unit corners and unit boundaries were completed, a crew was put into the field to establish the units. The Land Planning Engineer checked all applications of typical unit plans and made such adjustments as were necessary. In a few cases special plans were made to assure to each farmstead building group a dry location and a convenient, functional plan.

All buildings were staked out. In order to expedite the work of the construction engineers all batter boards and foundation elevations were set by the Civil Engineers. This work was carefully dovetailed with all other engineering work in order that construction sites would be ready considerably ahead of erection crews. It was necessary in many instances to construct the culverts for farm drives before the heavy trucks were able to enter the unit for unloading materials for the buildings. The farm drives were cut, graded and graveled later as the trucks would have ruined them. Barn lot fencing was laid out according to the Unit Plans prepared by the Land Planning Engineers. The construction of the fences and hanging of gates was supervised by the Civil Engineers.

The Civil Engineering work involved in the construction of the Southeast Missouri Project included practically all of the normal activities of the Civil Engineers in farmstead construction for the Farm Security Administration. Specialized engineering such as land erosion control, irrigation design and construction, and the design and construction of engineering structures such as major bridges, etc., were not necessary. It is preferable to perform the majority of the Civil Engineering functions prior to construction activities. On this particular operation the

Engineers performed a difficult feat of executing the five phases of work essential to these operations at the same time, instead of performing them in an ordinary sequence, as time and available personnel would permit.

LAND PLANNING ENGINEERING

The Land Planning Engineers coordinated the requirements of various other divisions and the technical sections of the District Engineer's organization, in effecting practical subdivision plans for the project. The boundary survey, Plate 5, located various topographical features such as roads, drainage ditches, levees, Railroad rights of way, etc. A tentative subdivision, using this boundary survey map as a base, was prepared in order to analyze all of the conditions of planning and construction.

The amount of land necessary to support complete subsistence and livelihood for a farm family, consistent with a forty year amortization plan of the necessary loan, revolved about a debt load approximating $6200.00. This consisted of land $2500.00, improvements $2500.00, and rehabilitation loan of $1200.00, at an average land cost of approximately fifty dollars ($50.00) per acre. (See Plate 1). It was necessary to plan for farms containing fifty acres of productive land or its equivalent of semi-productive land. Approximately one hundred farm units, having desirable building sites located on or convenient to existing roads and utilizing natural boundaries so far as feasible, were located.

The Home and Farm Management Personnel cooperated to establish certain fundamentals of farm unit planning both necessary and possible. This project was planned to be a part of the farming community of the Southeastern counties of Missouri without lifting its standard of living unnecessarily higher than that of the region surrounding. The same people who had lived on this land as sharecroppers or farm laborers were to be given an opportunity to farm for themselves. By design, an economical subdivision was established which, without upsetting the traditional standards of the region, provided not only present security for each farm family and included the possibility of a higher future plane of living. Schools, roads, and community facilities of the surrounding communities were used.

It was not possible to use some of the roads during the early stages of the program because they were unsurfaced and undrained. To solve this problem the Resident Engineer established a time schedule for the construction of all units which used the good roads in the early stages and gradually worked in other units as they were made accessible. All work of the Civil Engineers and the Land Planners was coordinated by this schedule.

The approximate geographic center of the project was at the junction of one east and west graveled road connecting the project with U. S. Highway 61 about two miles west of Laforge, and the Brush-Prairie graveled road which came into the other road at LaForge from New Madrid, which was about six miles south of LaForge. These two roads were the only graveled roads on the project.

A new gravel road was necessary to replace the old dirt road extending north along the levee from the principal east and west road. The use of this dirt road would have necessitated road improvements as well as a land subdivision presenting inconveniences to the farmers such as odd shaped and elongated farms and farms with parcels of land on both sides of this road. It would also have been impossible, using this dirt road, to subdivide the land which was assigned to units 30 and 31, without building a spur road to service one or both units. This new road, situated west of the old road on a ridge of substantially higher and better drained land, eliminated all of the old road and provided more healthful building sites. It is also more direct and there is less roadway to require maintenance.

New roads to service lands assigned as units 32, 33, 34, 35, 36, and to units 85, 86, and 87 were necessary due to the natural drainage conditions and the inaccessible nature of these locations. The new road alignments followed the ridge lands.

Certain lands lying in swamps and wooded areas were not subdivided because drainage lines had not been extended to include these areas. They were reserved for future expansion and present protection of the project.

The LaForge Cooperative Association was established to operate the cotton gin, community store, and blacksmith shop. The structures involved were grouped in the center of the project where the existing cotton gin was located. A Manager's house and a cooperative barn for the storage of machinery, grain, hay, and animal servicing, were made by remodeling existing buildings. These structures lie east of this center along the principal east and west gravel road.

One hundred farm units were laid out to insure the equal of fifty acres of productive land, situated on or convenient to existing roads with buildings located in such relation as to provide practical service, maximum convenience, sanitation and attractive surroundings for each farm family.

When practical, natural boundaries such as existing hedge rows, roads and drainage ditches were used as farm unit boundary lines.

It was practical and economical to standardize the planning and engineering work connected with the farm ploy layouts, due to the flat topography of the project land. Eight typical farm ploy plans were designed, each of which provided an attractive, convenient and sanitary arrangement of buildings, well, drive, fenced areas, gates, drives, etc. These typical plans varied sufficiently to fit the majority of existing site conditions. The equivalent of thirty-two different plan arrangements was possible by using alternates and reverses of each typical.

Certain definite policies were strictly observed in preparing these eight typical plans.

PLATE 8

The house was located forty to sixty feet from right-of-way line in order to provide convenience to the road in wet weather.

PLATE 9

The barn was located within clear view from kitchen door or window, and at least ninety to one hundred feet from house. The barn was located in the approximate center of the barn yard.

PLATE 10

The well was located convenient to, but at least twenty feet from the rear door. This minimum distance was established as a sanitary precaution found necessary owing to the local custom of housewives throwing slops from rear door. The well was also located a minimum of fifty feet from the barn yard fence as a precaution against barn yard pollution and also by the fact that fifty feet was the maximum distance which an above ground gravity-flow water line from pump to water trough would operate efficiently. The privy was located convenient to rear door of house and seventy-five to one hundred feet from well.

PLATE 11

Food Storage was located convenient to rear door of house.

PLATE 12

One third of an acre was fenced in as a Barn Yard. A twelve foot entrance gate convenient to road and the rear of house was provided and one twelve foot gate providing access to fields was provided. The entire area was kept nearly square to effect fence economy. One quarter of an acre was fenced in as a garden. One twelve foot gate located convenient to the house and driveway was provided. The drive was located convenient to house and garden and was as short and direct as practical.

PLATE 13

The following principles were observed in applying the typical unit plans to actual unit sites: All buildings were placed on well drained land; the house and well was located on the highest possible elevations in order to insure surface drainage away from both.

PLATE 14

The barn was located with reference to the house and the prevailing summer winds in a manner to insure safety in case of fire, and barn odors being blown away from house. The poultry side of barn was faced south or east (considered the favorable exposures for poultry houses in Missouri). When possible the privy to be located with reference to house and prevailing summer winds in a manner to insure absence of objectional odors. The food storage to be located so that door faces south or east.

PLATE 15

Final record drawings developed by the land planning engineers and used on this project included:

The subdivision plan, (see Plate 5)· and eight Typical Plot Plans with key to all symbols used, and 101 individual Farm Plot Layouts complete with a list of types and structures built on each homestead.

All work from architectural design to final construction was carried on at the same time, so absolute coordination was necessary. As soon as definite computations of unit boundaries were available, the Land Planning Section adapted one of the eight typical unit plans to the site and made final unit drawings. These final drawings were then used by the Civil Engineers in laying out units, establishing

corners, grades, and finally erecting batter boards to expedite construction.

A great many of the inconveniences of planning on this project could have been avoided if there had been sufficient time to allow plans and surveys to be made in sequence rather than all at the same time, as certain plans naturally depend upon foregoing studies and conclusions for their coordination.

WATER SUPPLY

As a result of a complete survey of water needs for the Southeast Missouri Project, the District Engineer directed that wells and pumping equipment be designed with the following general specifications: Water, wholesome and potable for domestic use, and free from bacteria contamination be supplied, in amounts not less than two hundred forty gallons per minute continuous delivery (per farmstead). The pumping equipment was to be designed to provide water by means of hand operation. It must have sturdy construction to insure long life and low-cost maintenance. The engineering design must protect the water supply from freezing and from secondary contamination. The prime cost of complete pump installation, including all necessary pipe and fittings, well screen, complete pump assembly and concrete platform, ready for use to be within the budget allotment of $31.00, direct cost.

A study of the geology of the Southeast Missouri Project made it evident that no difficulty would be encountered in securing adequate water through the use of shallow wells, commonly known as sand-point driven wells. To be sure that the water supply would be free from objectionable amounts of soluble minerals and bacterial contamination required a study of existing wells in the territory involved and also a general study of the geological formations in New Madrid County. The office of the Missouri Geological Survey at Rolla, Missouri was contacted as was also the State Board of Health office at Jefferson City.

Logs of drilled deep wells in the general vicinity of the project were studied. A well 505' deep known as the East Prairie Well drilled in Mississippi County, Missouri, located approximately 8 miles from LaForge and between that point and the Mississippi River furnished from its official record the following data:

	From	To	Thickness
Alluvial sands and gravel	0	135	135
Coarse sand	135	170	35
Fine sand	170	290	120
Coarse sand	290	310	20
Clay, gray	310	317	7
Fine to slightly coarse sand	317	345	28
Fine sand with some clay	345	365	20
Clay and fine sand	365	385	20

Fine sand	385	400	15
Clay with some fine sand	400	505	105

Sand had been encountered to a total depth of 364 feet, and from that point to the bottom of the hole the well was in clay. From the thickness of the lower clay it was assumed that the clay zone represented the so-called Porters Creek formation which underlies the water bearing sand of the Wilcox group in Southeast Missouri. This log and other studies substantiates the assumptions that the geology in Southeast Missouri is chiefly of an alluvial nature to a known depth of approximately 1000 feet. From other sources it was learned that the water supply in Southeast Missouri is of unusually high quality, being protected by one or more layers of clay hardpan which safeguards the water bearing gravel stratum from surface contamination.

Test borings were made at selected points on the project site by P. F. Rossell, District Hydraulic Engineer, in March, 1938. Records of these test borings were as follows:

UNIT 12

Materials Penetrated	From	To	Thickness
White gumbo topsoil	0'-00"	3'7"	3'-7"
Red Sand	3'-7"	16'-9"	13'-2"
Clay Hard Pan	16'-9"	17'-1"	0'-4"
Water bearing sand	17'-1"	18'-7"	1'-6"

UNIT 15

Top soil	0'-00"	1'-00"	1'-00"
Sandy red clay	1'-00"	4'-00"	3'-00"
Reddish sand	4'-00"	5'-00"	1'-00"
Red clay sand	5'-00"	9'-6"	4'-6"
Clay hard pan	9'-6"	16'-6"	7'-00"
Coarse Water bearing sand (strong water flow)	16'-6"	19'-6"	3'-00"

UNIT 74

Top soil	0'-00"	2'-6"	2'-6"
Clay hard pan	2'-6"	3'-6"	1'-00"
Medium sand	3'-6"	8'-00"	4'-6"
Water bearing sand	8'-00"	13'-10"	5'-10"

UNIT 79

Materials Penetrated	From	To	Thickness
Top soil	0'-00"	1'-6"	1'-6"
Clay	1'-6"	2'-10"	1'-4"
Red Sand	2'-10"	5'-6"	2'-8"
White Sand	5'-6"	8'-8"	3'-2"
Clay hard pan	8'-8"	9'-5"	0'-7"
Red sandy clay	9'-5"	10'-7"	1'-2"
Coarse gray water bearing sand (strong water flow)	10'-7"	12'-10"	2'-3"

Study of these test borings showed that the expected clay hard pan stratum was encountered in all test holes. This proved the decision to use driven wells of the shallow well type sound and that pumping equipment and well design could safely be developed from this starting point.

The design of the pump itself is such that ample protection is provided against contamination by bugs, dirt, bird lime, etc., which are effectually kept out by means of a packing gland at the top of the pump body. This sanitary feature is worthy of comment when a comparison is made with conventional open top pitcher pumps. The closed top pump design also prevents debris such as nails, buttons, bottle caps, etc., from being dropped into the pumping equipment by children with resulting damage to the pump cylinder and cup leathers.

The well design itself provided protection of the basically good water supply against local contamination. The force type pump was attached to a steel well casing 4 feet long. This casing served as a housing for the well cylinder, an essential element of the force pump. In order that the pumping equipment be protected against damage through freezing, a weep hole was provided immediately above the cylinder which automatically lowers the water in the pump itself to the location of the weep hole. The sandy nature of the soil would provide adequate drainage of the run-back water, dissipating the water in the ground. A concrete platform was cast in place about the well casing.

The pumps were located to provide drainage away from the concrete platform. The local grades determined the elevation of the pumps, but it was felt safe to design the steel casing as one length. This meant that the lower end would be set in each case, at an arbitrary elevation. In about

8 cases the lower end of the steel casing ended in stiff clay or gumbo, which would prevent proper leaching of the waste water. In these particular cases it was found necessary to use a longer length of steel casing to reach into sand or gravel and provide an outlet for waste water essential to prevent freezing in cold weather.

Specifications resulted in the procurement of the pump illustrated. Sturdy construction and adequate protection of the water supply against freezing is provided for in this design.

The total on-site construction cost of these wells included pumping equipment, pipe, fittings, sand point, concrete platform, etc., was $24.24.

<u>PLATE 80</u>

HOUSE DESIGN

The policy conferences, decisions on-site, studies and analysis, made in conference with the management personnel, the conclusions, decisions, orders and instructions issued by the District Engineer, enabled the Architectural Staff to proceed with the initial steps for the design of the house.

Analysis of the basic data established the basic design standards. The total cost of the houses should not exceed $1,300.00 each, including all on-site and off-site expenses that may be properly termed costs to this project. The house should be of Southern farm home style, one story, frame on masonry piers, with simple gable roofs. Two sizes of houses should be designed. The first to be a base plan approximately 24'-0" x 24'-0", and consisting of two bedrooms, combination living room dining room, kitchen, with two porches. The second to be approximately 24'-0" x 32'-0" and consist of three bedrooms, combination living room dining room, separate kitchen, and two porches. These plans should be studied with the idea in mind of future expansion and modernization.

The plan layout should express a maximum utility of space. All rooms should be carefully studied for ventilation, circulation and orientation, light and possible furniture arrangements. Each bedroom should provide adequate space arrangement for placing two full sized double beds and include closet facilities within the rooms. Living rooms should be large enough for the activities of a farm family and so arranged that one end would be used as dining space at meal times without destroying its function as a living room. The kitchen should service the dining space of the living room and also the rear screened porch. A chimney should be so located as to serve both kitchen range and the living room circulating heater by direct flue connections. The kitchen should be arranged for farm cooking, canning, wood box, storage of supplies, pots and pans. It should include built-in cabinets and cases with sink, drainboard and waste run-off. A rear porch, screened from insects, should not only provide a covered entrance to the kitchen door, but be large enough to be used as dining space during the seven or eight months of warm weather. A front porch, not necessarily screened, should be used on road elevation each house.

The houses should be structurally sound, using materials which conform to recognized standards of dimension and quality. Consideration must be given to using surplus materials from other Farm Security Administration projects.

Foundations should be masonry piers on footings, provide positive anchorage of the house to the ground, and elevate it sufficiently above grade to allow circulation of air for the prevention of rot from ground moisture. The platform framing of wood girders and floor joists should be designed to carry the loads to be imposed upon them, with necessary bridging. It should be well tied together and anchored to the piers. The finish floor should be laid on building paper over a sub-floor.

Walls and partitions should be wood framed, with building paper and wood siding as exterior finish, using vertical boards or other dry materials as interior finish. The walls should provide resistance to wind loads of severe velocity. Roofs and attic should be wood framed, provide protection from the weather, ventilation, insulation and dead storage facilities.

Tentative sketches, (based on these basic design standards), were prepared as a basis for cost analysis. These sketches were prepared without reference to material as it was necessary at this stage to show only limits and direction of planning. The base plan sketched provided two bedrooms, each approximately 12'-0" x 12'-0", separated by closets taken partially from each room, a common living room dining room kitchen, 12'-0" x 24'-0" with a chimney and stud wall serving as a screen for kitchen activities. By adding 8'-0" to the length of the building and reversing the direction of the living room dining room, space was provided for a third bedroom and a separate kitchen, without changing the major construction of the house or the position of the chimney.

Modernization plans were studied in order to prove the possibility of future remodeling. By adding another eight feet to the length separation of the living functions into a distinct living room, dining room, and kitchen, disposed in fan shape around the original chimney was possible and an economical plan for providing bathroom, utility space, circulation hall developed. The base plan and the second stage plan were judged to fit the basic design requirements from the standpoint of plan layout. The possibility of economic future additions seemed feasible, so alternates of exterior appearance were studied for variety.

PLATE 16

Wood was the most desirable building material to use in spite of the disadvantages of the high cost of maintenance and fire insurance. Wood is economical, has broad application as a material used in rural structures, and is obtainable from stock throughout the country in dimensions and quality that conform to national standards. Its use in this region would help to offset the disadvantage of a general lack of skilled mechanics in all fields of construction. In addition to the above reasons, there was available about $40,000. in surplus materials from other Farm Security Projects. The range of dimension and quality of these materials appeared to include useable material for the construction of Southeast Missouri Farm Houses.

Sketches were prepared to determine the most economical arrangement of interior and exterior floor supports and resulted in the decision to use a line of girders through the center of the house and one at each side. This gave two equal span lengths of 2 x 8" floor joists, 12'-0" long, and satisfied simplicity standards, economy of materials, and plan function. This decision avoided unequal span lengths, not considered economical because safe loads computed for one span length would be too great or too small for the other span length. Special sizes of materials were avoided for economy. Special sizes are generally cut from the next largest standard piece and the remainder wasted.

Lumber Standards were coordinated in this design by means of a governing overall design grid or module, which acted as a structural or design center line and confined lengths and sizes of materials to the industrial standards. A module width of 2'-0" was selected for use in these designs.

All plans have exterior dimensions of multiples of 4'-0" or two module widths, and partitions and walls were centered on one or another of the 2'-0" spacings. Windows and doors center on a bay two modules wide; closets are one module deep by two modules wide; and all room sizes are multiples of definite modules, which is of particular advantage in controlling the placing of structural members. The height dimensions were more or less controlled in the same manner, but only within the economic advantage. There was no attempt to force all materials into the modular dimensions.

Piers were 8" x 8", in cross section and 2'-0" long, with a length of strap iron (standard commercial pipe hanger)

running through the pier and projecting from the top and bottom. The projection from the top of pier was to be nailed to the girder system to anchor the house to the pier. The projecting end on the bottom would tie the pier firmly to the footing. This footing was to be mixed and poured as a field operation with the precast piers placed before the initial set had been made, squared and aligned correctly and backfilled to hold in place until complete set had taken place. The footings were to be poured 8" deep and 20" square, without forms other than the walls of the excavation.

The girders, in span lengths of 8'-0" were first designed to be built up of 2 x 8" material, but because of the necessity to use surplus materials were changed to a single 2 x 12" with a 2 x 4" ledgerboard as bearing for the floor joists. The center girder was made up in the same manner except that a ledger was placed on each side. Spacing over piers remained the same because the truss system of roof constructions gave practically the same design loads on each girder. Calculation of loadings showed that the load was well distributed if the piers were spaced 8'-0" on centers. This dimension gave pier sizes and weights that would easily be handled by two men. It also allowed the 2 x 12" girders to be used in lengths immediately available in surplus.

Girders were tied together on the gable sides by 2 x 12" trimmers 12'-0" long and scabbed in the middle over the center pier. 2 x 8" joists, 16" on center were dropped down between these girders and rested on the ledger. A single row of 1 x 4" crossbridging was placed in each 12'-0" joist span. The entire platform was tied together by sub-floor of 1 x 6" tongue and groove, laid perpendicular to the joists.

The walls consisted of a 2" x 4" bottom plate, 2" x 4" studs on 2'-0" centers, and single 2" x 4" top plate. This design was possible because the roof load from trusses occurred directly above the studs in every case and no eccentricity of loading was possible. The exterior finish of novelty drop siding was put directly over paper on the studs. This is characteristic of Southern frame construction, and gives sufficient insulation for the particular climatic conditions to be encountered in South East Missouri, (with sheathing omitted).

Roof construction consisted of trusses built up of 2 x 4" ceiling joists in 12'-0" lengths scabbed in the center on

both sides by 1 x 4" scabs 2'-0" long. The rafters were cut from 2 x 6" material 14'-0" long, nailed at the heel, cut to the ceiling joists, and scabbed at the comb. This truss depended upon the developed nail strength at the ends and center, which calculations showed to be sufficient. The bottom chord (ceiling joists) was not stiff enough to support the ceiling load, so hangers of 1 x 4" material were put in at the quarter points. Wood shingles were used as roof covering put on 5" to the weather over 1 x 4" shingle lath, 5" on center, standard spacing for quarter pitch roof. 2 x 4" members were placed diamond fashion beneath the rafters to insure greater stability against torsional wind stress.

Interior finish of 1 x 6" tongue and groove vertical boards, "V" jointed, were used both on the exterior walls and partitions. Finish yellow pine wood floor was laid over building paper. The ceiling was finished in 1" insulation board put on in sheets 4'-0" x 8'-0".

The floor and ceiling was laid complete before erecting the curtain partitions, thus avoiding cutting and fitting around the partitions. This was made possible by the use of the roof truss.

The architectural expression of these houses followed the same trend observed in local building, which gave wide latitude in the design of cornices, rakes and cornerboards. The rafter was left square ended and a facia of 1 x 8" covering was put over the ends, projecting 3/4" above the rafter to start the roofing lath, and projected below the rafter 1½" to cover the edge of the soffit and act as a drip. The soffit was a 1" x 4" with quarter round mould to cover the joint at the frieze to avoid a close fit. A 1" x 10" frieze board (belt course) was blocked out over the siding beneath the cornice, the bottom edge lined up with the head of the windows to act as a head casing.

The gable ends were treated in a manner similar to the cornice with a double rake board up to the ridge simulating the line of an overhang. The frieze was carried through, across the top of the window openings with a drip cap above it. On gable ends, a 1" x 6" corner board was used. Window casings, door casings, pilasters, and all corner boards were placed on top of the siding in order to avoid making a close fit.

The interior dimension of finished wall material was 8'-0" and all other height standards were established from this.

Most interior finish materials come in lengths of 8'-0" and widths of 4'-0". The window head height was set at 7'-0" to correspond with the bottom of the frieze board and to permit the use of a 7'-0" door height.

Windows were 10" x 12", 12 light, double hung sash with spring bolt control. It was not believed necessary to use the more expensive counter-balanced sash for this type of house. Kitchen sash was 10" x 12", 6 light bottom hinged, interior swinging casement, also of wood. Doors were 3'-0" x 7'-0". In order to use surplus materials some 2'-8" x 6'-8" doors were used. Doors and windows were designed to center on a double module of 4'-0" or two stud bays of 2'-0" each. This allowed for a standard treatment of trimmers around the openings.

Panel sizes were studied for the most convenient dimensions for handling. Panels could be made up wall height and almost any multiple of 2'-0" in length. There was, however, the weight factor, the production factor, and size for convenient handling to be considered. Study of placement of doors and windows and exterior appearance caused by batten strips over panel junctions indicated that as large a panel unit as was convenient should be used. Panels 12'-0" and 8'-0" long would fit all conditions of design and yet not be too heavy for convenient handling. The largest panel weighed approximately 400 pounds and could be handled by a crew of five men. A schedule was drawn up to show the number of different panels necessary to make up the houses. Several types of corner joints and batten joints to be used with panel construction, were studied.

The preliminary plans were drawn, including sections, elevations and details. The placing of doors, windows, porches, etc., and the details of bridging, nailers, blocking, etc., worked out easily and accurately under the grid control. These plans and the tentative specifications were estimated and submitted in conference. The estimates were checked by experienced construction engineers and any possible savings due to production methods were calculated. These conferences between the Architectural, Engineering and Construction Staffs of the District Engineer's Office, assigned to this particular structure, were stormy affairs. The results, however, proved the necessity of such coordination if progress in construction of this type is ever to be developed. It was agreed that it would be possible to construct the houses designed within the budget figure, although many changes were made, to allow a greater margin

of safety and to more closely coordinate plans with construction methods. Some changes were made to better satisfy "use" demands.

The District Engineer decided to move the Architectural Staff to the job site at LaForge, Missouri, to execute the final plans. As it was necessary to provide an office for this staff, he decided to construct smaller houses by shop fabrication methods. This would involve the least capital expense, serve as a proving ground for the principles of design and construction, and this house could later be removed to a unit site and completed for farm use. He believed that actual contact in the field of the design, production and construction forces would clarify many problems and enable changes to be made quickly and efficiently. Upon arrival on the job site at LaForge, Missouri, temporary design quarters were set up in one wing of a permanent building that was to be used as the office of the Resident Engineer of Construction.

Sketches of the necessary templates, framing tables, and jigs were made, and temporary plant operations scheduled for the production of the first house. This house was the 24'-0" x 24'-0" type. It was decided that all interior finish, corner boards, battens, etc., would be left incomplete for purposes of economy and to expose the construction joints to the criticism of all the technicians concerned. The Architect and the Resident Engineer collaborated on the supervision of this operation because of the opportunities it gave for coordination. Instruction was necessary to adjust the habits and experiences of the carpenter mechanics. This labor was easily trained and supervised, because the jigs did their thinking for them. Everything operated according to schedule and a week after arrival at the site, experimental prefabricated panels, trusses, gable ends, and all precut materials were ready for the erection of the first house.

A Saturday morning was picked for the trial. The District Engineer assembled as many of his staff as were available, to sit as a jury during the entire erection and to assist by critical comment in the actual process. The morning was occupied in the setting of piers and building the platform of girders, joists, and sub-floor. By noon this was completed and all prefabricated materials loaded on trucks. This operation was studied for handling and a ten mile road test was made to study the effect upon the sections of loading arrangements and of delivery over rough roads comparable to the worst conditions that would later

be encountered on the project. Rain commenced in the early morning and by noon turned into a driving sleet that froze over everything, decidedly inconveniencing the workmen. This turned to snow, which before the end of the afternoon came down so thick and fast it was difficult to see more than twenty or thirty feet. It was a severe trial to erect a building in this type of weather, but operations proceeded as scheduled on the theory that the severe conditions would prove a better test.

The truck load of panels was backed up to the platform and erection started promptly at 2:00 P.M. The panels were slid off the end of the trailer and were dropped on their corners to the platform, a distance of about two feet. This was a test not planned, but due to the icy condition of the truck and platform it was impossible to handle them carefully. The eight side wall panels were erected in a little over a half hour and all were true and square in spite of the severity of the test.

The two gable end panels were next erected, without the use of scaffolding, and were in place and temporarily braced by 2:47 P.M. The gable end panels had been brought in vertically through the door and one end raised at a time using the same crew of five men. The District Engineer decided this operation too great a strain on the men. The high wind velocity increased the danger of accidents. He directed the Construction Engineer to use a gin pole for this operation in the future.

The prefabricated trusses were next raised in place and two methods were tried out to establish the more economical. A scaffold was used for the first half. This truss could be raised in place without the use of scaffolds. The scaffold was taken down and two men sat on the top of the wall panels. A lead-off man walked on a temporary plank which he moved along the top of the ceiling joists and spaced the trusses with a marked roof lath which he nailed temporarily as each truss was raised. The other two men brought the trusses in through the door and raised them up to the men on the walls. These men placed them with the ceiling joist directly over the studs, thereby eliminating the necessity of measuring and plumbing. The operation without scaffold proved more successful. By the end of the afternoon all trusses were up and the roof lath placed.

The following day was devoted to test and criticism. The walls were carefully tested for square and alignment. One

roof truss was rigged up with strings and bobs plumbs to check stresses and deflection. It was overloaded with sacks of cement and the weights of workmen to almost five times the design load; men hung on the bottom chord while photographs were being taken to show loading and deflection. The deflections were measured at all points and showed none in excess of the allowable deflection for plaster ceiling, which certainly proved the truss amply strong enough for 1" insulation board finish.

The spread at the plates was carefully measured, certain features of the experiment being conducted twice for this purpose. It was found to be well within all essential factors of safety. The sufficiency of the nailing on all members was carefully studied by inspection during and after test. Practically all nails were found in direct shear stress. This nailing was considered more than adequate but a few adjustments improved future construction.

Conference discussion of the tests and criticisms brought out that the operation was entirely satisfactory from a standpoint of feasibility of design and construction, but, that there was not sufficient cost data available to determine its economic value. Certain changes and corrections were directed made in various phases of design and construction methods. The District Engineer decided to erect two more houses on their unit locations; one to be erected of materials precut in the shop and the other of sections prefabricated in the shop. He directed that a careful comparative cost should be kept of both operations in order to bring out all significant items of difference, such as handling materials, labor, and qualities of construction. Production plant methods should be closely studied for both operations with a view to rearrangement for economics. Truck loadings should be studied and scheduled according to crews, operations, time, etc. Study should be given to the arrangement of final drawings by plans, specifications, and quantity survey of materials to fit production plant methods.

During the conference, criticism was directed at the design of the joint construction. The original method had been planned to give absolute flexibility of panel arrangements. The District Engineer decided that since there was no decision to prefabricate the interior partitions, the extra flexibility would be dispensed with in favor of a more simple joint construction. The walls, which had been centered on the module before, were placed so that the interior of one side and the exterior of the

other side was on the module, which gave a simple butt joint.

The houses to be built for the directed experiment were 24'-0" by 24'-0" each and were on contigious lots. One house was the alternate of the other, materials were practically identical and the operations on both houses could be easily studied. The District Engineer and members of his staff attended this erection.

The conference and criticism which followed brought out that although the cost comparison was not complete at this time, the prefabrication method promised the most economic construction. The high class of labor demanded by field erection of the house was not available in the vicinity of the project. Four carpenters, who had to be laid off on the field erection operation, worked very well on the prefabrication operation. The labor quality on the prefabricated house was apparently better. A greater part of the construction of the prefabricated house was done in the plant under supervision. Even greater efficiency was promised by better organization. The impassable condition of the roads and expected bad weather were at this time very evident. The District Engineer summarized these conclusions and issued the order that all plans and operations should be immediately pointed toward the full production of the house and barn, by shop fabrication method.

The District Engineer made a breakdown of plans by steps and carefully coordinated the plan sheets to illustrate each operation. The changes and recommendations noted in the last conference were ordered incorporated in final drawings. Complete control drawings were directed drawn including plans, elevations, sections, and details. Complete shop drawings, covering in detail each separate precut and prefabrication operation required for one house, such as girders, joists, studs, panels, trusses, etc., were directed drawn. Complete field erection drawings showing each operation to be followed in assembling the various precut and prefabricated units comprising one house, were directed drawn. Complete indexes and material control sheets, designed to consolidate the material and cutting schedules were ordered prepared and drawn on each of the shop and field drawings. Assembly jigs, templates and framing tables that would be necessary for shop fabrication were directed to be designed. A production plant material flow chart was worked out and directed to be drawn to scale, showing receiving facilities, space required for stock, precut, and prefabricated materials, arrangement of

equipment, and lines of material flow in operation. Various control diagrams, graphs, and schedules necessary to the accurate timing, ordering and accounting of all materials, labor and equipment, were worked out and directed to be prepared.

PLATE 17 is an index which outlines the final house drawings.

Control drawings were prepared and carefully reviewed to insure inclusion of all changes and recommendations directed in conference.

PLATE 18 illustrates the foundation plans and shows layout and details of piers and footings.

PLATE 19 shows the cross section.

PLATE 20 shows the floor plan.

PLATES 21 AND 22 illustrate the four elevations.

PLATE 23 shows the electrical plan.

These were also used as field erection drawings to cover the exterior finish operation.

Shop drawing for piers is plate # 24 . The piers were 8" x 8" square and 2'-0" long with all corners beveled. Galvanized, perforated pipe hanger straps were placed running continuously through the piers and projecting at each end. The projection at the bottom was 3" to provide anchorage of the pier to the footing and at the top 9" to provide anchorage of wood platform to the pier by nailing through the perforation. The pipe hanger strap was placed in such a manner that a single standard pier would fit all girder conditions found in the house with the design load falling on direct center bearing of the piers.

The shop drawing for the panels are plates # 25 to 34 inclusive. There were ten sizes of panels originally planned, eight of them 12'-0" long and two 8'-0" long. After the District Engineer ordered that only three-bedroom houses be built, only eight different panels were required.

Shop drawing for window and door inserts are Plates # 35 to 39 inclusive. These drawings cover the operation of

rough framing of trimmers, sill, head, etc., around the openings planned to be a separate fabrication job from the wall framing. Windows and doors were designed to occur in the exact center of two stud bays so that the framing of all would be similar, and could be easily standardized for precutting and prefabrication.

Shop drawing for the gable end panels is Plate # 40 . This drawing covers the fabrication of the gable ends which were made up in complete units for each end of the houses above the wall plate lines. The design of these panels is simple, with as many square cut fits as possible, in order to avoid mitre cutting which was an operation not easily possible with the gasoline saw equipment. In place of a top plate, standard rafters were used flat against the inside face of the studs to be nailed to the plate at the ends. This gave the same triangular construction as a roof truss and required less care in fitting.

The bottom plate was 2 x 6" material in 12'-0" lengths, scabbed in the center and served not only as plate for the crippled studs, but also as ceiling nailer for the interior ceiling finish. Crippled studs were fastened to this plate on 2'-0" centers designed to be exactly above those in the wall panels. The center stud was left out for the insert of the framing around the louvre. The louvre itself was made up in rectangular shape to avoid mitre cutting. The crippled studs were square cut as was the siding, (all designed to be precut).

Shop drawing of the roof truss is Plate # 41 . The truss was designed to be built in the same jig as the gable ends.

Shop drawing for the "B" nailers is Plate # 42 . These so called "B" nailers were 2 x 4" nailers, designed to be made up in strips either 8'-0" or 16'-0" long. They provided cross nail bearing for the interior ceiling finish and were nailed to a plate forming a comb-like shape that automatically centered the ceiling joists on 2'-0" centers and could be adjusted easily with the joists by sliding. "A" nailers or those blocks between the trusses on top of the wall plates were sent to the job precut in standard sizes. Their functions were to provide nailing for the ceiling board around the perimeter.

Shop drawings for porch floor and roof panels are Plates # 43 and 44 . The original porches had been made up as precut material only and put together in the field. They were designed in two sizes for the different functions of rear and front porch using permanent screen panels, shop fabricated for the rear porch. This considerably

complicated the job of finishing because the porch rafters rested on the same plate as the house trusses and had to be placed before the roof could be shingled. This also multiplied the special plans and handling at each job. The District Engineer directed that porches be designed as separate entirely from the house. To secure standardization, a single size was chosen, 12'-0" x 8'-0", and so arranged that screens were demountable for the rear porch, and could be replaced at any time by storm sash. The porch floors and roof decks were made up as panels and so designed that they would fit beneath the cornice of the eaves and against the frieze on the gable side. These were shop fabricated in the same manner as other panels, the roof section being finished complete with metal roofing and flashing.

Shop drawing for porch steps is Plate # 45 . Steps were made up with finished treads and enough material allowed in the carriages to be fitted to the grade line. This was possible on this project because of the extremely level topography.

Shop drawing for precutting templates is Plate # 46. It was found necessary to have a complete sheet of details of all material to be precut with other than straight square cuts. It had been noted before that the number of these had been kept at a minimum because most of these cuts were hand operations or at best a difficult operation for the gasoline, cut-off equipment.

Shop drawing for gable end louvre is Plate # 47 . This is a complete sheet of details, elevations, and templates to cover mill fabrication of louvres for the gable ends of the houses.

Shop drawings for window, door and porch screens are Plates # 48 , 49 and 50 .

Shop drawings for kitchen cabinet details are Plates # 51 , 52 and 53 . These drawings cover the complete fabrication of kitchen cabinets, sink, drainboards, and other cases to make up the whole unit.

Shop drawings for window and door frame details are Plates # 54 , 55 , and 56 .

Field erection drawings for setting piers are plates # 57 , 58 , 59 and 60 . These plans show details and all dimensions and materials necessary to complete excavation,

pouring footings, and setting of the piers. It was also used by the engineers in conjunction with the unit plot plans to guide them in staking and setting batten boards. These plans show dimensions of footings for piers and chimneys and gives the correct turning of the perforated strap for best advantage.

Field erection drawings for floor framing is Plate # 61 . This plan shows all details, materials, and general plans necessary to completely frame the platform. All materials necessary are given a symbol to be put on each piece during the precutting operation in the shop, with the exception of the sub-flooring.

Field drawings for panel erection are Plates # 62 , 63 , 64 and 65 . These sheets were used to control actual panel setting, sequence of loading, unloading and erection. All field connections are shown.

Field erection drawing for roof truss erection is Plate # 66 . The plan of all houses was the same at the roof line, after the order of the District Engineer to stop building the smaller house. Only one sheet is therefore necessary. This sheet shows the placing of the gable end panels, the trusses, both "A" and "B" ceiling nailers, bracing, the cat walk in the attic.

Porch erection plan is shown by Plates # 67 and 68 . As all porches were treated as a separate and complete addition to any house, and as they were designed to fit both on the eave and gable sides of the houses, one plan covers the entire operation. All the necessary plans, elevations, and details are shown to fit all conditions. Had these porches, as originally planned, been built at the same time as the rest of the house, all plans would have had to be multiplied by two or four, and a corresponding number of production orders, material lists, and schedules would have had to be prepared, thus complicating operations. This is one instance in which actual production plant operation had a large hand in the design.

Chimney erection plan is Plate # 69. This plan shows only the dimensions and details necessary to place and build the chimney in relation to the rest of the building which is only outlined. The chimney was of brick with clay flue tile and corbelled brick cap. The foundation was of concrete block on poured concrete footing which was put in at the same time as the house piers. This chimney was carefully designed to be executed at a time which would

not conflict with other work, and to be built complete from foundations at one operation, to avoid cutting structural members. The chimney was 1'-5" square with a single $8\frac{1}{2}$" x $8\frac{1}{2}$" terra cotta flue tile with two metal thimbles projected into it. This was consistent with local practice in that region and no fault of draught has been noticed even though both thimbles are being used at the same time.

The ceiling erection plan is Plate # 70 . This plan covered all the work necessary in placing the ceiling of 1" insulation board and designed nailers necessary for the operation. The joints between panels of this insulation board were simple square edged butt joints and are only slightly noticeable after two coats of light colored casein paint.

The interior partition erection plans are plates # 71 , 72 , and 73 . These plans show interior finishing of partition, closets, doors, cabinets, etc. They were made separate from the control drawings in order to keep operations divided. These plans include also the location of wind bracing, partitions, closets, doors, etc.

Master material cutting lists were prepared, Plates # 74 , 75 , and 76 , to check quantities of materials as listed on the separate shop and field plans, and from which quantity surveys and material lists could be prepared. These materials have been completely broken down to show quantities, qualities, symbols of use, actual sizes and lengths of materials and a consolidation table prepared from the list of stock materials entitled "to be cut from". Plates 77 , 78 , and 79 are the material cutting lists for the mill work.

Assembly jigs, framing tables, and templates were made from free hand sketches and altered to suit each change made in design and operation. These freehand sketches illustrate the simplest possible wood frames or tables, with blocks or notches so placed to align and hold precut material in position for nailing together to form panels or other prefabricated units.

Certain conclusions regarding the design features of the house seem advisable in this report. The control drawings as presented were perfectly satisfactory for the operation of Southeast Missouri, but, several changes might be helpful, if used for other operations, These are not standard architectural drawings and should not be considered as such. All plans might be drawn with center lines of all

interior partitions, exterior walls, closets, etc., exactly on module, thereby permitting greater standardization and allowing interior partitions to be prefabricated. In this manner, both exterior and interior finish materials will work to absolute standards of material or to standard cuts of this material. The ceiling and floor could then be made in standard panels of two or three sizes, cutting well from standard materials. This involves an additional amount of cutting and nailing figured by length of line. The standardization achieved may lower cost of production and erection handling by eliminating time generally spent in interpretation of drawings and layout work, and thereby improve control of all operations.

The plans might be drawn on small standard sheets, including only one plan to a sheet. Modular lines would be dimensional, and include plan details of all junctions arranged to read properly. One portion of the sheet might include, complete specifications of materials, executed in a tabular form of schedule easily read for purposes of quantity, survey, estimate, material orders, and absolute shop and field control. Other sheets showing sections, elevations, and millwork would be designed in a similar manner. Absolute control of any job is possible through complete and clear drawings expressing the desired architectural and construction design and this is particularly true in planning for production operations in which small errors and omittance are exaggerated by the number of units being produced.

Shop drawings were satisfactory but might be revised to better coordinate them and their utility to more complete control plans. Shop drawings might also be prepared to cover the design and construction of all assembly jigs, platforms, templates and to illustrate their operation. Field erection drawings might be revised to agree with more complete control drawings and might be further supplemented by a manual of erection operation more clearly defining the exact sequence of each operation.

The District Engineer directed, after conference with the Management Division, that the basic design standards set up for general control of the design of houses on this project should include planned studies for future modernization and expansion.

PLATE 16 illustrates these studies.

The plan noted as "A" is the original small two bedroom type shown for complete sequence. Plan "B" is the second

stage or twenty-four by thirty-two foot plan secured by lengthening Plan "A" eight feet at one end. Prefabrication of interior partitions would greatly simplify the re-arrangement of spaces necessitated in expansion, remodeling and modernization.

Plan "C" has been drawn to show the addition of modernization features to the original plans in the most economic method possible. Comparing plan "C" with Plan "B", an addition of a single eight-foot bay to the living room-kitchen end of the building makes possible rearrangement of these rooms and gives additional space for a bathroom, closets, hall and allows the dining activities to be separated from those of the living room. The kitchen remains in the same space it occupies in the original plan, but is rearranged for better function in conjunction with the new dining room. No partitions are disturbed, but it is necessary to move the exterior end walls out and add two panels to make the extension. A bathroom and additional closet space for linens and coats is placed in the angle formed by the three original bedrooms which it will not be necessary to disturb. This feature separates the plumbing supply and waste lines of the new bathroom fixtures and those of the kitchen, but plan efficiency of the arrangement should offset the additional length of pipe run necessary.

The following sequence might be employed in constructing these modernizations. Three additional piers are required. These can be placed by repeating the former end wall detail. Temporary blocking and bracing should be placed inside the existing living room and kitchen to support the roof construction while the necessary wall panels are freed and moved. These panels should be stripped of battens, cover-boards, and frieze and cut free with a metal saw. This operation has already been executed quickly and efficiently as a mistake in erection made a shift in the panels of one house necessary. Further experience in the taking apart of these buildings and moving the same to another site was gained when the temporary office building was taken down, moved to a site on the project, erected and completed.

The new girder extension should then be placed, using scabs and metal ties to insure good construction joints. The end wall girders may be re-used without cutting. The only additional material required for the floor system will be three girders 8'-0" long with ledgers, eight joists, and necessary bridging and flooring.

The panels should be rearranged and erected in the same manner as originally, two additional panels and certain revisions of the existing ones being made on site. It will not be necessary to strip the entire interior finish from these existing panels because the new nailing may be done through the finish, both from the inside and the outside, into the floor system.

The original gable end panel can be re-used and erected in the original manner. Four new roof trusses are needed. Additional shingles, roofers, cornice, frieze, and bracing will, of course, be required. The original ceiling need not be disturbed any further than resetting the end sections and adding the new pieces after the new trusses and other sections are in place. The existing house is finish floored in the direction of the joists so need only be added to as required for the extension.

Prime painting of the new section will, of course, have to be done before an entire finish coat is given in order to blend the new addition to the existing part. The front porch will have to be moved, but as this was originally planned as a separate section it will be neither an expensive or difficult operation.

The cost of the new improvements will depend on the manner in which they are executed, as volume of construction is a very necessary adjunct to the economy of such an operation. The actual additional space required should cost not much more than twenty-five per cent of the original construction so the total cost will depend entirely upon the fixtures for the bathroom, plumbing layout, hot water heater, septic tank and grease trap, field of agricultural drain tile for disposal of waste, and a pressure water system for the operation of the plumbing. The cost of the latter will depend somewhat on the availability of electric power for operation of the well pump. Certain technical studies will be necessary in order to establish the economy of these modernizations, such as the laying of septic tank and disposal field owing to the high water table, and also insulation of all plumbing lines coming in contact with the outside air.

BARN DESIGN

The District Engineer, following the general policy conferences, on-site inspections and conferences with management personnel, gave specific instructions, directions and data which enabled the personnel assigned to design the barn to begin operations and prepare tentative sketches.

Local conditions affecting the barn design were: flat topography, high water table, sandy and alluvial soil tending to blow and erode from piers, frequent high winds, mild winters and hot summers.

The barn must provide for 2 mules, 1 cow and calf, pen for miscellaneous use, 40 chickens, 300 bushels of ear corn, 8 tons of hay, room for cottonseed and feed storage, and a wagon shed, to meet the planned agricultural program. Total cost not to exceed $600.

The farm management personnel offered a sketch of a barn which had been built in the area of the project in rehabilitation work which satisfied their use requirements and the conditions peculiar to the project. This barn was built on piers, and the animals were loose in pens. No insulation was required.

Construction Engineers pointed out that surplus building materials were to be used in the construction of this project before purchasing new material and that the barn design should be flexible in the use of various kinds, sizes and lengths of building materials.

The Chief Architect in charge of all design work had in mind the development of house design of the Southern type of architecture. He required that the barn be designed to harmonize with the house.

Based on this data, sketches and requirements obtained from farm managers, construction engineers and architects, free hand studies of a barn plan were made. These studies followed the sketch furnished by the farm management people. These studies were approved with the exception of the roof shape which was required to be changed from a gambril roof to a low lying gable roof to harmonize with the house design.

Farm economists objected to the design because of the small hay capacity provided by the low gable roof. They would not approve the plan without increased hay capacity provided by the gambril roof indicated on their original sketch. The construction Engineers had estimated the barn would cost $592. They pointed out that the base price of $600. was a total cost which would have to include overhead items and the barn as designed would therefore cost too much. The architects would not approve of changing from the gable roof to a gambril roof because such a barn would overshadow and detract from the house. Taking into account these conflicting opinions of utility, cost and appearance, the District Engineer ordered the plan to be discarded.

A discussion followed the discarding of the first preliminary plans aimed at securing a common basis for a second design. Seeing that this discussion was getting nowhere, the District Engineer made a rough sketch of a pole type barn observed to be extensively used in this area, and offered it as a solution to the problem. This idea suggested a central hay mow extending from the ground to the roof with pens and storage rooms on both sides. He further suggested incorporating the poultry house into the barn to add some money to the barn.

Farm management planners objected to Poultry house in the barn as impractical; the loss of hay in contact with the ground; the inconvenience in caring for livestock because it was necessary to go outdoors to go from pen to pen or carry feed from feed room to animals; and the fact that mangers had to be filled from behind the animals rather than from a feed alley in front. Construction Engineers objected because of the large number of doors and because this suggested plan covered about twice as much ground and roof area as the first preliminary sketch. They thought it would cost more to build. The architects objected on the ground that this squatty type of building was foreign to the project region.

Despite these objections by the farm management economists to its utility; of the engineers to its cost and the architects to its appearance, the District Engineer directed that a trial plan be drawn. Work was started on the preliminary plan and was completed. At LaForge, consultation with the farm management planners and the Construction Engineers on-site, finally produced a tentative design approved by all concerned. The level topography and soil conditions, the uniform type of farming to be practiced,

the mild climate and especially the standard of living and abilities of the people dictated that one type of barn with a simple plan and simple mass should be designed. The direct cost of the barn should be $500. and in order to keep below the budgeted amount all factors would have to be cut to the minimum and possibly some eliminated.

The barn to be constructed of wood material using the post type of framing set on concrete piers. This type of construction, when applied to small buildings, provides the maximum amount of floor space and cubage at a minimum cost. The hay load rests directly on the ground, eliminating heavy floor joists and girders. Purlin posts and purlins break the rafter spans. It is well suited for piers, eliminating a continuous foundation; the vertical siding carries some of the structural load; diagonal braces built into the wall cut the effective span of the plates, and transfer the loads from the sills directly to the posts and piers.

The general floor arrangement was to be a central hay storage extending from the ground to the roof and running the entire length of the barn. Pens for the various animals to be along one side of this mow and space for ear corn, cottonseed, feed storage, and the chickens along the other side of the hay mow. A shed for machinery storage was to be along one end of the barn. This was essentially the same idea as suggested by the District Engineer in the second preliminary plan. It was found that most of the objections became unimportant when local conditions, type of farming planned, and especially the needs of the people were studied on-site. The farm management technicians were satisfied with this plan because it gave a larger floor area than the first preliminary plan. They suggested the elimination of the wagon shed in case it was necessary to cut cost in order to meet the budget.

The central hay mow to hold 8 tons of hay, required approximately 4000 cu. ft., (at 500 cu. ft. per ton), or a space 13 feet wide and 30 feet long by 11 feet high. The actual designed floor space was 12' x 30'.

The Animal Unit along one side of the mow housed 2 mules requiring a box stall of 10' x 10' minimum size without manger; a pen for miscellaneous uses, also a 10' x 10' enclosure, and a pen for a cow and calf also 10' x 10'. Total floor space designed was 10' x 30'.

The Crop and Poultry Units along the other side of mow required space for 300 bu. ear corn or 750 cu. ft., (at $2\frac{1}{2}$ cu. ft. per bu.), A space 10' x 10' with average height of 8' gave 800 cu. ft. Forty Chickens required 160 sq. ft., (at 4 sq. ft. per bird). A space 10' x 15' gave 150 sq. ft. A room 5' x 10' would be large enough for cotton seed and sacks of feed. Total floor space required was, therefore, 10' x 30'.

Wagon and machine storage as originally planned called for a space 12' x 29' along end of barn. The size of the barn, determined from the space requirements, was to be 32 feet wide and 30 feet long with the shed 12 feet wide along the 32 foot dimension or the width of the barn. The height of the barn was to be 8 feet at the eaves, and 16 feet to the ridge. The barn was to be almost square in plan with a plain gable roof. The exterior appearance was to be kept clean cut and simple and to harmonize with the general low lying effect desired in the Southern type house.

Careful consideration was given in planning for possible prefabricated panel construction. Practically all parts of the building could be designed for panel construction. Panels were to be of such size, weight and shape as to be easily handled by four Southeast Missouri men and to suit legal requirements for highway transportation. Panels were to be so complete that when all were erected, the barn would be finished except for corner boards, cover strips over the panel junctions and a final coat of paint. Panels should be interchangeable, as much as possible thus limiting the number of different shapes, sizes and kinds of panels. Sawcuts on pieces were to be simple as only gasoline power-drawn table saws were available in the way of equipment. Panels were to be simple and require no special set of tools or skill for assembly. Panels were to have diagonal bracing to prevent them from getting out of square in handling and transportation. Panels members were to be cut from stock sizes with no loss.

Working upon these basic ideas of cost, construction, prefabrication, arrangement, size, and appearance, plans were drawn. In order to get order and direction in the plan and adapt the building for panel construction, it was necessary to use some definite unit of width and breadth. It soon became apparent from a study of the various space requirements that 10 foot was a common horizontal dimension. The same gird or module system used in developing the house designs was employed. The barn plans were laid

out using a 10-foot unit, the barn being 3 units long and 3 units wide, with a 12 foot unit in the center hay section.

End panels were designed to lay past side wall panels. This end lapping is possible in the barn as there is no interior finish and an extra $7\frac{1}{4}$" length of barn is secured. To avoid cutting some panels to below 10 feet, the size of the building was first increased to 32'-0" x 30'-$7\frac{1}{4}$", the $7\frac{1}{4}$" being equal to the thickness of two panels 3-5/8" thick. These dimensions were later increased to 32'-$0\frac{1}{2}$" x 30'-7-3/4", the additional half inch being necessary to take care of the gain in effective panel length during erection.

The precast pier block was made 8" x 8" square and 16" long. 8" x 8" was determined to be the minimum safe size to bear the load while the 16" length was the minimum which would allow the block to be placed 6" above the grade and reach to the safe frost and wind action depth in the ground. This size could be easily handled. The edges of the block were champferred to prevent the edge being chipped in handling. A 2'-0" x 1/8" x 1-1/8" steel strap of pipe hanger material was run through the length of the block to anchor the block to the footing and the barn sill to the pier. Pipe hanger material was used because of its cheapness, its availability, workability, strength, and the fact that regularly punched holes permitted easy nailing to the sills, providing wind anchorage for the building. The strap was extended 5 inches above the block which was just enough to allow maximum nailing to a 6 inch sill and not extend above the sill to be in the way of future construction. It extended 3" below the block into the footing to provide bondage. There were two center posts setting directly on center of the piers. Pier designs for these posts were shown with $\frac{1}{2}$" round rods to permit anchorage by means of doweled construction.

Footings were figured as 18" square for all piers except those under the two posts which were made 24" square. These sizes would take care of any load occurring on the pier with a large factor of safety. The tops of the piers were placed 6" above the finish grade line. This height was a compromise of conflicting factors. It was the minimum height necessary to get the wood sills, girders and siding out of the mud and away from conditions of rooting and it was the maximum height which allowed animals to step over the sill at doorways. Piers were set as outlined in house design.

The sills and girders were figured according to the loads coming upon them. Two 2 x 6" on edges and one 2 x 4" flat were selected for the sills, because it permitted using the 2 x 4" as the lower member in the panels if prefabricated. An additional 2 x 6" or a total of three 2 x 6"'s was placed under the center bearing partitions. An additional 3-2X6" center girder was required under the corn crib. The design of the corn crib presented several problems. The large lateral pressure required figuring the studs for bending and for secure fastening at their reaction points. Joists and girders had to be figured for bending and shear and the piers spaced and sized correctly for soil bearing.

Sills and girders were built up rather than of one piece construction, because of the size of the material available, the additional strength of a continuous beam over a simple beam and because continuous beams tied the whole system together. A more even and level sill top was secured by counteracting the bow and crook of one piece against that of another being nailed to it and a straight and level sill was required for an accurate fit of panels. Difference in cost and availability also favor the lighter pieces. All sills were specified to be constructed of cypress for durability. Top plates were built of two 2 x 4"'s, placed flat, here again allowing for the lower member to go with the panel and the upper plate to be nailed on after the panels were erected breaking joists between panel joints for lamination effect. A 2 x 8" cypress mud sill was nailed on to the regular sill on the inside of the barn. While this piece was figured as merely a protective member, it also added strength to the sill system. It extended about half way below the sill to keep the manure and fill away from the barn sill and was so attached that it could be replaced when rotted.

Framing followed the generally accepted post type of framing with posts, purlins, plates, nailers, and braces. The various pieces were so sized and designed as to be either prefabricated in the shop or erected by ordinary field construction methods. For example, wall posts were shown as two 2 x 4" instead of one 4 x 4". This would permit, if prefabrication method were used, of attaching one 2 x 4" to one panel and the other 2 x 4" to the adjoining panel. When erected the 2 x 4"'s would come together and form a built-up 4 x 4" post. Purlin plates were built up of two pieces, one vertical, the other horizontal, these two pieces making an L. This type of built-up member is strong and rigid for roof construction, because it can

take both the horizontal and vertical component of the rafter thrusts.

A 10-foot basic wall panel framework was laid out to guide design requirements for panel construction. This basic wall panel framework consisted of seven members. Members 1, 2, 3 and 4 are principal members forming the shape and size of the panel and a base for nailing the siding. They also serve for nailing the panel to other panels or units of the building. Member 1 also forms part of the barn sill. Member 2 forms a part of the barn plate; and members 3 and 4 each form one-half of a barn post. Member 5 serves as a nailer to break the span of the siding and is a header for all window openings. Members 6 and 7 serve to brace the panel and brace the barn. Most of the panels in the barn conformed to basic wall panel unit. There were 27 panels in the barn with only two exactly alike, yet the difference between many was very small. Often the only difference would be a reversal. Different panels were made simply by shifting the inner members or exchanging different length pieces.

All 4 gable panels were the same size and same triangular shape, but one had hay doors and another a corn crib filling door. The gable panels were planned to offset 3/4" over the wall panels below. This was to allow the siding to lap over the wall panel siding, securing a rain tight joint and a simple method of joining the two panels. The plate of the gable panel and the upper plate of the wall panel formed the two 2 x 4" barn plates. 2 x 4" rafters were placed 24" on center. Light snow load, light wind load due to the flat angle roof, light roofing load, due to slatted sheathing spaced 12" on center and the short rafter span, due to the purlin breaking the rafter span, were considerations in this design.

The siding was 1 x 6" V drop siding applied vertically. Vertical application was selected over horizontal, because it was more fitted to the post type of framing, added strength to the walls, could be precut with all pieces the same length, tied the roof, walls and sills together and was weather tight. V siding was used rather than other patterns of drop siding suitable for vertical application because it had less lines and gave the appearance of wide boards, thus adding to the clean cut appearance of the barn. A large supply was on hand as surplus material. 1 x 4" boards, spaced 1" apart were used to side the corn crib. The siding of all side wall panels was notched for the rafters to avoid measurement and notching on the job.

Roofing was of $1\frac{1}{4}$", 28 gauge, 2 ounce, zinc coated, copper bearing corrugated iron and was laid over 1 x 4" roof lath spaced 12" on center. 1 x 6" starter pieces were placed at the eaves and gable and in the middle where the roofing was planned to lap. Other types of roofing were considered. The roof slope was 5 to 12, flatter than the quarter slope accepted as a minimum for wood shingles. It was not feasible to increase the pitch which would result in longer rafters, more roofing, more gable wall, etc. The composition shingle type of roof, both in shingles and in rolls, was rejected because of the high winds occurring in the project area. The standing seam type of metal roof did not fit because skilled labor experienced in laying the roof could not be obtained.

Wood floors were necessary beneath the corn crib, feed room, and chicken pen. Rat proofing was considered for the corn crib and feed room floors and walls, but, was ruled out because of cost. To rat proof these rooms, all partitions would be lined with $\frac{1}{4}$" mesh galvanized hardware cloth, to be placed between the studs and lining. All exterior walls would be lined with $\frac{1}{4}$" mesh galvanized hardware cloth 2 feet above the sill bottom, applied between the studs and siding. A ribbon of sheet metal 8" wide would be nailed on the outside of the siding at the top of the hardware cloth to prevent rats climbing up the wall and gaining entrance above. All floors under the crib would be lined with the same hardware cloth between the joists and flooring. Earth floors were indicated in the animal pens and hay storage. Poles were to be laid over the hay storage floor to keep the hay off the earth.

Doors became a difficult problem in this design. There were 12 exterior doors and 3 interior doors, to give the required access and circulation to the various units of the plan. All doors were made the same size insofar as possible and built with battens of 2 x 4" material to reduce warping. Doors were sided with the same material as the barn siding to avoid detraction from the surface appearance of the buildings. Trim and casings were eliminated for economy. The doors were built in the same plane as the siding to allow building a door as part and continuation of the siding in panel construction. The door could be sawed out and swung free after the panel was erected. The batten framework and hinges of all doors were so located that any door could be sawed in half horizontally through the middle to form Dutch doors. This cut was to be made at a 45° angle for a stop action between the doors. Dutch doors are especially suited to this region because the upper half can be opened for ventilation

and the lower half will serve as a gate. Doors were all hinged to swing out, saving space inside. The insides of the doors were painted, not only for the appearance when the doors were open, but also to reduce warping.

Two windows, using wood barn sash, were located to provide light for the animal section. An opening without sash, but screened with poultry netting was provided for the chicken area. The open window was preferred by the farm managers because it would permit the entrance of the ultra-violet rays of the sun excluded by ordinary glass.

All partitions were arranged for panel construction. Interior panels were made of solid construction lined with 1 x 6" D & M material or 1 x 4" lath spaced 4" apart. The partitions around the corn crib, feed room and chicken pen were run to the roof to keep corn, feed, hay, etc., from spilling over into adjacent areas. The partitions around the animals were run 8 feet high, and the little hay that would hang over, added to the hay capacity of the barn.

Mangers in the mule stalls and cow pens were planned to be prefabricated in panels or units. Boards of the mangers were run the short way, thus providing an outlet for left-over short pieces. Badly warped, cracked or otherwise damaged boards could be sorted out and cut up for use in these mangers. Nests and perches were designed to be prefabricated. Kick boards were placed on the inside of the two exterior panels of the mule pen.

Upon completion and inspection of these third preliminary plans, the District Engineer ordered one barn built to test the cost, prefabrication possibilities, and the design. From a cost estimate taken off the plans, it seemed that the cost might run over $500., so he ordered that the wagon shed be omitted. Workmen were assigned and the design and construction engineers cooperated in the operation. Rough pencil sketches were made of each panel. The architect supervised the carpenters in the construction of the panels and precut parts. These rough sketches later served as a guide in making the shop assembly drawings.

The test barn was built in the presence of the District Engineer and members of his staff. The barn could be built for $500. The sill and girder system had to be square, straight, and especially level. A slight hump or depression in the sill would cock a panel out plumb, leaving a crack between the junction of it and the next panel. The seriousness of this was noted by an effective gain in

length of the panel, with the accumulating error of each amounting to 2" on a side of the barn. It was decided to add $\frac{1}{4}$" to the length and width of the barn for each panel. Thus a 10-foot panel would actually cover 10-0$\frac{1}{4}$" and still be in standard length of material without waste. The panels would have to be assembled in rigid jigs and between rigid blocks to assure accuracy in size and squareness. Sawers would have to work on rigid tables with carefully and securely placed stops in order to cut all pieces the same length.

Following a general inspection and discussion of the barn, the District Engineer ordered certain revisions: Piers were to be adjusted so that the building loads would come on the centers of the piers rather than along one of the sides as constructed. Interior panels between the animal units and hay storage were to be slatted with square edge 1" x 4"'s spaced 4" apart instead of 1" x 6" D & M material used. This made an appreciable saving in lumber and provided a use for the large supply of 1" x 4" material on hand. The poultry house wood floor was to be omitted. This was recommended by the management as a possible saving in cost. Otherwise the plan was satisfactory and approved.

The District Engineer ordered the construction of two more test barns, one by panel prefabrication in the Assembly Plant, and the other the standard erections on the site with pre-cut materials. Both barns were built in the presence of the District Engineer and members of his staff. In the prefabricated job, everything was built in panels or assembled units except the roof. In the other barn, all pieces were precut in the assembly yard and trucked to the field for erection. It was the opinion of some of the staff of the District Engineer that nothing would be gained by prefabrication, the barn being of rather simple design and construction. They argued that the barn could be built just as cheaply and quickly on site by ordinary methods. Others felt that because of the simplicity, the barn would lend itself to prefabrication. It would be possible to prefabricate at least 95% of the barn in panels or assembled units. After the panels were erected, the barn would be practically completed except for a few pieces of trim and a final coat of paint. Records showed that it cost 48 man hours more to build by on-site methods than by panel prefabrication in the assembly plant for these test barns. A check on the quality and quantity of workmanship indicated that a larger amount of supervision would be required for the field method of erection. The

District Engineer, as a result of these demonstrations and the records established, ordered the final plans be drawn for panel prefabrication with the exception of the sills, floors, and roof.

Plate 81 is an index to the final record drawings for the barn. Plates 82, 83, 84, 85 and 86 are the record and control drawings showing the floor plan elevations and cross sections.

Field erection drawings were to be made to cover the sequence of erection. These drawings were to be clearly detailed and illustrated by pictorial drawings so as to tell the field crew what, how, when and where each separate piece and panel was to be used on the job. Each phase of the erection was shown on one sheet or series of sheets in order that the sheets could be used as illustrations in separate job orders. All pieces of material, panels or assembled units were to be listed separately with each phase of the work and be given a mark or symbol number. Plate 87 gives general erection instructions. Plate 88 is the pier layout. Plate 89 shows the girder plan and 90 the erection details. Plate 91 illustrates the panel erection plan. Plates 92 and 93 show the erection of plates, posts, purlin, rafters and roof. Plate 94 illustrates manger erection and plate 95 shows details of floor construction.

Shop assembly drawings tell the "how", "where", "when", and "what" to do in building the panels or prefabrication units in the central assembly plant. Only one panel was shown on a sheet in order that the sheet could be used to illustrate the "job orders". All pieces of material making up the panel were to be listed as to mark, use, number, size and length and kind of material both precut and raw. All panels were shown with a mark or erection symbol. Plate 96 gives general instructions for shop assembly. Plates 97 to 121 inclusive illustrate the barn panels. Plate 122 illustrates the barn piers.

Precut drawings were ordered which showed dimensions and size of all precut pieces, so that templates could be made for every piece having diagonal cuts. A mark was required for each piece. Plates 123 and 124 show precut details.

In order to simplify bookkeeping, writing job orders, prefabrication and erection procedure, a complete bill of material was to be made for the barn. All precut

materials going into each and all panels and prefabricated units was listed. Secondly, all raw materials used in building each and all panels and prefabricated units was itemized. Finally, all precut or raw material erected in the field was listed. Materials were listed and summarized according to a mark use, number of pieces, size, length, and kind of material. Plates 125, 126, 127, 128 give these material lists and summaries.

This barn may be enlarged in several ways. Larger hay capacity may be obtained by increasing the width of the hay section, or by adding to the height of the hay section, pushing the roof of the central hay section upward to form a monitor roof. This method avoids disturbing the animal pens and storage rooms on the sides. An alternate method would increase the stud height which would also add hay storage over the animal pens, but necessitate floors.

The barn may be lengthened to accommodate a larger number of animals, in which case the hay capacity is automatically increased to balance the requirements of more animals. If the barn is planned for a Class "A" dairy barn, it would be desirable to widen the animal section so that a feed alley could be located in front of the cows. Other features such as concrete floor, gutters and mangers, proper lighting and tight separating partitions would need to be included. Animal capacity may be increased by removing the chickens from the barn and substituting livestock in their place. This would probably be a wise change because chickens are more or less of a nuisance around a barn and do better when isolated.

A continuous concrete foundation may be used instead of the pier and sill construction. This is more expensive but a more desirable construction method. Wood shingles may be used by increasing the roof pitch.

There are possibilities of utilizing this type of barn for different uses. It can be readily adapted as a straw shed, beef cattle barn, sheep shed and machinery shed as well as a general purpose barn as planned. Changes in position and sizes of the doors would be a major item.

FOOD STORAGE DESIGN

There were many factors and requirements which influenced the planning of the Food Storage Building. The special local conditions, construction engineering requirements, and Architectural requirements were similar to those for houses and barns. Home Management requirements were the real guide to this design. A Food Storage Building was necessary to store the fruits, vegetables, canned foods, and meat products which were to be raised on the farms and used by families.

Only one plan was required, inasmuch as the need for all farms was about the same. The plan had to be flexible to permit adaptation to different topographical conditions. Cost should not exceed $150.00. Interior arrangement should provide for adequate shelving, floor space for crates and ceiling hooks for hanging meats. The interior to be protected from the entrance of vermin. Possibilities of being cleaned and being made sanitary should be provided. The building should maintain a proper and constant temperature to prevent freezing in winter and rotting in summer. It should maintain a proper humidity in order to keep fruits and vegetables plump and free from shriveling. Air motion to control humidity and keep storage free from odors should be provided. Light was not required. Building materials containing objectional odors such as creosote, not to be used in the building because of the absorption of odors by the fruits and vegetables.

First consideration was given to the materials to be used in construction. Food authorities generally recommend utilizing the fairly constant temperature and humidity of earth excavation or fill where mechanical refrigeration is not considered feasible. Cave or bank type cellars need masonry construction where the structure is permanently in contact with the earth. Poured concrete is homogeneous and resists the passage of water through the wall, but lacks the virtue of air-spaces found in commercial masonry units such as concrete blocks, terra cotta units and similar materials. The sizes used in the preliminary sketch were adequate for the food storage requirements of the average family on a family size farm. The 6'-0" x 8'-0" dimensions of the floor plan were adjusted slightly

to permit the use of standardized masonry blocks without cutting or chipping. The ceiling height was fixed at 7'-0", as being most practical and economical to construct.

The question of elevation of the food storage floor with reference to the existing and variable finish grades is one of engineering choice. A high water table on a given building site dictates the location of the floor above the water table to guard against flooding. Providing for the mechanical removal of such flood waters exceeded the cost budget. In the absence of a high water table, and with sufficient natural grade to give gravity drainage to a non-flooding outlet, the floor can safely and preferably be located a maximum distance below grade of 2'-6" and still use a grade line door within the building dimensions without resort to below-grade steps. The deeper the building can be set in the ground with adequate and necessary natural drainage, will reduce construction costs by requiring less earth fill around the completed building. Another very desirable advantage of locating the building as low as possible is that cooler earth temperatures and a higher earth humidity are secured.

Proper ventilation of a food storage structure is equally important with proper temperature, necessary humidity and protection against damage due to freezing. The type of roof used must be considered in the ventilation question since ventilation ducts must start and end at points on the exterior of the building. In this case a gable-type wood roof was selected for two reasons. The first and most important consideration was to provide an attic through which air would flow naturally and thus facilitate proper ventilation. Appearance of the completed structure was the second reason. The original sketch provided a louvre frame in each gable to insure a free movement of air at all times, and formed a direct pneumatic connection between the attic and the outside atmosphere. The vent arrangement consisted of a 4" x 12" galvanized duct leading from one corner of the attic to a point within 12" of the floor and a second short duct of the same dimensions located in the diagonally opposite corner extending through the ceiling only. Thus a long vent leg was paired with a short one to induce a natural circulation of air in a vertical circuit. A vent opening in the lower part of the door and a field tile set through the wall just below the ceiling on the wall opposite the door is another solution to this problem.

"Duckwalk" board floor, loosely placed on a concrete floor provided a dry footing at all times and furnished free circulation of air under and around hampers or crates. These were to be stacked around three walls to a maximum height of 3'-0". Shelving started at this point and extended to the ceiling on three sides, for canned goods.

A flat concrete roof was considered but was eliminated from the original sketch because it did not provide an attic which could be used as part of the ventilating plan. Aside from the probably additional cost, a concrete slab roof could be used and mounded over with earth, forming a perfectly satisfactory roof that would require no replacement on maintenance as is true of a metal roof. Since the ceiling was thoroughly insulated against extreme temperature changes, it becomes immaterial whether a wood shingle roof or a corrugated sheet metal roof be used.

Wing walls were not provided to hold back the earth fill around the door. The three most exposed sides of the storage are adequately banked with earth, and the door in all cases faces either east or south. The winter sun thus helps to keep snow and ice from accumulating in front of the door and supplies considerable solar heat to protect the door end of the storage against freezing. The external appearance of the completed storage can be greatly improved and even developed into an attractive feature of the premises by the use of field stones or boulders to form a permanent toe for the earth slope, and then beautify the earth mound by the judicious planting of flowers, shrubs and grass.

The building was bank type of masonry construction with the exception of the roof which was to be a frame construction. Earth was to be banked around the building up to the eaves. In a bank storage cellar, or one in which the storage room is largely below ground level, the temperature is largely determined by the temperature of the surrounding earth, which is about ten degrees above or below the ground temperature depending upon the season. The earth serves as a temperature regulator and gives some assurance in the proper and constant temperature which, while not perfect for storage purposes, is workable most of the year. The moisture of the earth passes through the masonry and into the air inside the building, and results in a high relative humidity so necessary to prevent fruits and vegetables from shriveling.

This size, 9'-6" x 6'-10", was estimated as the maximum possible to build with the money available. This dimension figured to concrete block sizes. The interior arrangement was simple. There were three rows of shelves 12" wide running around three sides of the building, the lowest shelf three feet above the floor to allow the use of all the floor for crates. Loose crates were selected over built-in bins because the latter could not be removed and cleaned. All parts were to be planned for prefabrication if possible. The building being generally of masonry construction, this was limited to the gable ends, roof trusses and entrance doors.

Ventilation was secured by placing double inlet doors at the bottom of the entrance door and a tile outlet at the top of the wall. These openings to be screened against the entrance of flies and small animals.

The earth was to be banked up around the building to the eaves of the building. In order to steepen the angle of the bank and to protect the entrance door, "sandbags" were to be indicated around the doors. The sandbags were to be filled with earth and seeded with grass seed. After the bags rotted away, a sod would have formed, capable of holding the bank at a steep angle of repose. To drain the building a 4" drain tile was shown running around the building at the natural grade line. This tile line to be carried to an outlet. The concrete floor was easily cleaned, rat proof, and suitable for damp conditions.

Two possible locations of the grade were to be indicated. This was to be done to show the possibilities of adapting the building to different water tables and topographic conditions. Grade A was used where the building could be built lower into the ground; grade B being for conditions requiring erecting the building on top of the ground.

The ceiling was to be 1" x 6" D % M material. Water proof paper was applied between the boards and the ceiling joists to retard the moisture of the storage from passing through into the insulation of the ceiling. Walls were insulated by the earth backfill. Four inches of insulation was indicated on the ceiling between the joists. This insulation to be of a mineral structure to reduce deterioration.

Doors to be placed in the gable end to provide access to the attic and a possible means of ventilating the attic. Galvanized corrugated iron was selected for the roofing material because of the surplus on hand. The small opening under the corrugations would also provide some ventilation

to keep the attic insulation dry. The entrance doors were to be of double wall constructions with 2" of insulation, embedded between the D & M boards. The doors were to be beveled and stopped to fit snuggly around the edge and prevent air leakage.

The District Engineer approved the preliminary plan and the final plans were drawn. Plate 129 illustrates Food Storage Plan No. 4112:20 A-B-C. Three buildings were drawn on one sheet to accommodate different site conditions, the only difference being in finish grade, which affect the height of the entrance doors and steps into the building.

CONSTRUCTION

The Construction Engineers received their initial instructions on-site at Southeast Missouri prior to the selection of on-site construction personnel who would perform the actual operations. The general outline of the surveys made, the conditions analyzed, and the conclusions reached during the initial construction engineering survey have been outlined in the section on General Design and Construction Activities.

After the selection of the key personnel to actually supervise the on-site construction operations at Southeast Missouri, all of these conclusions were carefully analyzed with this personnel and the initial steps taken to mobilize men, material, and equipment to accomplish the job.

The first and most important problem concerned men. Construction activity is primarily a result of the ability of the men assembled to do the work. Certain peculiar conditions necessarily attach themselves to construction work performed by governmental organizations, especially those of a temporary nature, created for a definite purpose.

The labor was to come from the territory immediately surrounding the Southeast Missouri Project. The people who were to be housed on the project, whenever they were available for utilization as construction labor, were to have first preference. Those persons living in the vicinity of this activity who were out of work and on Relief Rolls had second preference. The third class selection of labor to be employed on this project were persons who were specially qualified for construction work and who lived in the vicinity of this project, but were not on Relief.

In order to assure that these conditions are met on any governmental construction activity, the Construction Engineer is prohibited from designating individuals or employing them himself. He must analyze his problem, determine the quality and quantity of labor required and requisition the same from an entirely separate governmental organization. The United States Employment Service is established throughout the country by the United States Department of Labor. It has complete machinery for cooperating with local agencies and registering local labor of

every class and type. When it receives a requisition from a Construction Superintendent, it fills this requisition by certifying from its records the names of persons previously registered. These records show men who most nearly conform with the qualifications listed in this requisition. The men so certified are notified and report to the employing agency. It is the duty of the United States Employment Service to attend to the classification as to need as well as to ability and to see that the persons most in need of work and the persons coming from the area closest to the site of work are certified first for these operations.

Even before general plans based on conference decisions with design personnel and general directions given by the Sector Engineer were completed, the Construction Engineers were able to estimate the quality of skills that would be required. In general this would be three classifications: supervisory personnel, skilled labor and unskilled labor.

The initial survey was made on-site by the engineers themselves, in checking the possible classifications of the prospective homesteaders. The sixty (60) white men and forty (40) negroes who had been living on this land for the past years had engaged almost exclusively in cultivating the land for cotton and corn on a share-crop basis. It is doubtful if more than one-half dozen of these men had ever performed construction work of any kind. They were unfamiliar with tools and methods of work. There were some special skills such as truck drivers, etc., in which they had qualifications higher than unskilled labor. It might be stated at this point that where they were employed, every one of these prospective homesteaders made up for his lack of skill by his interest, enthusiasm, and hard work. This may have been due to the fact that they were working on a project preparing homes for themselves, and it may have been due to the fact that the twenty-five cent (25¢) an hour wage rate represented more actual money per unit of time than they ever had been able to make in this particular locality.

Wage rates was the second major consideration that the Engineers had to consider. There is maintained in the Farm Security Administration a Department concerned with Labor Relations. It works in close cooperation with the United States Department of Labor and on all such work is charged with the responsibility for recommending rates to be paid for each class of skilled labor or class of operations that are undertaken. It is also charged with the

investigating of the availability of labor and assisting the Construction Engineers in securing, through the local agencies, the proper quantity and quality of labor. Incidentally, these officials are also charged with inspection and supervision affecting labor conditions such as limitation of working hours, safety and sanitary provisions at the site of the work, and general supervision of the compensation activities under which each employee enters when he is employed. They afford an independent agency, which reviews and investigates all complaints, handles all adjustments that are essential either between the supervisory personnel and labor employed, or between supervisory personnel and any other agency in the community affecting labor.

The Labor Relations Representative on the staff of the Regional Director of Region III was contacted and he made an exhaustive study of the labor situation in New Madrid and surrounding Counties, contacting employers, employees, and Governmental Agencies. He recommended the labor rates to be enforced on this project and the hours of work to be ovserved. He further investigated most carefully the availability of labor. The rates established for employment at this project are given below:

Common Labor	$ .25	hourly
Watchman	.25	"
Building Construction Laborer	.35	"
Blacksmith's Helper	.30	"
Electrician's Helper	.35	"
Plumber's Helper	.35	"
Well Driller Helper	.30	"
Hod Carrier	.35	"
Pipe Layer	.75	"
Bulldozer Operator	.40	"
Grader Operator	.40	"
Tractor Operator	.40	"
Machinist	.70	"
Mechanic	.60	"
Lather	.75	"
Well Driller	.60	"
Blacksmith	.60	"
Brick & Stone Mason	1.25	"
Carpenter, journeyman	.75	"
Cement Finisher	.65	"
Electrician	.75	"
Painter	.65	"
Plasterer	1.00	"
Plumber	1.00	"
Sheet Metal Worker	.65	"

Checker	$ .50	"
Junior Checker	.40	"
Senior Checker	.80	"
Labor Foreman	.50	"
General Field Foreman	175.00	monthly
General Carpenter Foreman	160.00	"
Chimney Builder	.75	hourly
Dredge or Power Shovel Operator	.80	"
Pump Repair Man	.50	"
General Labor Foreman	150.00	monthly
General Yard Foreman	150.00	"
Yard Foreman	125.00	"

These rates were emanately fair, not only to the purely local laborer, but to members of employee organizations and others who had to come from some distances.

The sufficiency of labor report showed that there was an unlimited amount of unskilled labor. It would probably be about 60 to 65% white labor and 35 to 40% colored labor. It indicated that there would be a very serious lack of skilled labor in every class, and that such of the skilled labor as was obtainable would have to be supplied by secondary sources, such as Poplar Bluff and Cape Girardeau. This scarcity is best evidenced by the fact that the first requisition for skilled carpenters called for 25 men and only five (5) men were referred who could be retained on the job in this classification. It is further evidenced by the fact that bricklayers for the erection of chimneys had to be imported from St. Louis. It might be noted at this point, that most of the labor certified in the classification showed a very fine spirit and were easily adjusted to these conditions. It might also be noted that the Project provided a market for practically all skilled labor in the South East Missouri area who were not already working.

These preliminary requirements concerning the classes and quality of labor were about as far as could be undertaken until the plans for the job were further advanced, with the exception of discussing the type of supervisory labor, making a careful analysis of their qualifications and furnishing this analysis to the United States Employment Service at Sikeston, so that an effort could be made to locate men of this caliber. Two (2) General Construction Superintendents would be necessary for this work, one to handle all yard operations, and one to handle erection in the field. Each of these Superintendents would need a number of Foremen to direct the actual operations.

The Yard Superintendent would need a Foreman to handle all trucking and transportation operations; a Foreman to handle all mill operations; a Foreman to handle all general yard operations such as unloading of materials and equipment, the operation of certain labor functions such as precasting plants, etc., within the yard itself; and a general storekeeper to handle, in addition to other items, the stacking and handling of lumber including the receiving, storing and shipping of certain raw materials such as shingles, bricks, flue lining, etc.; A foreman to handle all precutting and prefabrication operations for houses; a Foreman who would handle all precutting and prefabrication for barns and outbuildings.

The Field Superintendent needed a Foreman to handle foundations who would also handle fencing and construction of wells; a Foreman to handle the erection of houses; a Foreman to handle the erection of barns and outbuildings (including food storages); a Foreman to handle painting. It was also estimated that he would need a Foreman to handle all repair and remodel work that would parallel the new construction work and be kept separate from it.

Very careful specifications concerning the type of men needed and the technical and skill qualifications which they must possess (in general to be reported on by the United States Employment Service on the basis of their experience records) were drawn for each of these men and supplied to the United States Employment Service at the earliest possible date so that they could be able to make a careful survey of their own records and those of the surrounding territory, to secure as many qualified candidates for these positions as possible. It is an interesting commentary on the fact that skilled construction personnel was not available in the vicinity to note that we secured only two men from this source. The two superintendents were referred from this source but came into this area from other areas where they had had broad experience in Government and civil construction work. Two of the men referred as Foremen were qualified and remained in positions selected throughout the job, one of them being of exceptional ability. All other Foremen were promoted from men referred as skilled laborers and were trained in the proper performance of their duties by the Superintendents during the progress of the work.

The preliminary work of the Construction Engineers in regard to material and equipment possessed some unique features on this particular job. They considered material and equipment together because they were directed by the

District Engineer that they must first utilize all available equipment and all available materials from the surplus stocks from the surrounding projects (and in the case of equipment throughout the United States) before they could make up lists for the purchase of new equipment or new material. This involved work in addition to what would usually be undertaken at the beginning of such a project.

There is another feature which must be considered in this regard which is best illustrated by an example. Rubber boots were needed on this project very badly. A supply of rubber boots was shipped to this project as surplus material. Out of six pairs of such boots received five pairs were worthless due to holes and bad condition by the time they arrived, and as a coincidence, the day of their arrival was on one of the worst days of the rainy season.

Another difficulty was that in many cases projects had been completed and closed down. If surplus material was to be shipped, all material and equipment on the project, irrespective of its value, had to be shipped as a matter of economy. The paper work for accounting for the receiving and inspection of one 8 foot piece of Dolly Vernon siding was just as difficult as the accounting for one carload of standard 2 x 4 x 12's.

In many cases lumber was scheduled for use in construction, and when it was unloaded, was found to be scaffolding and form lumber. This kind of lumber was needed, but if the Engineers estimated that they were receiving construction lumber material and purchase orders were made on that basis, they were short by the amount of this type actually delivered. Every effort was made in the initial stages to appreciate this condition, to anticipate it, and to plan to intelligently protect against such occurrences.

The first problem was to determine what equipment was needed and when it was needed. There was no electric power on the project. To operate power equipment or even furnish lighting in the Engineer's office or the designer's office, etc., local power had to be generated. There was a considerable amount of power equipment in surplus stocks and some of this equipment was shipped to the project under the assumption that a generating set might be set up on this project and later used for installation on another finished project, where it would be necessary to generate the electricity.

PLATE 131

Although attempted, this particular transaction involved the use of money of two different classes for two different projects and proved to be entirely too difficult to handle through Government Treasury Procurement processes. It was necessary to provide gasoline driven saws which could be used so long as we could keep the motors in condition and supplied with gasoline.

PLATE 132

As a matter of fact the only power generated was developed by a home made generating set consisting of gasoline engines originally purchased for the operation of saws or concrete mixing apparatus hooked to generating sets that had been purchased for various and sundry purposes throughout the country. Sufficient power was thus created, so that when the lights were off, a few small electric tools could be driven.

It was necessary to determine the method of operation before the equipment needed could be intelligently outlined. Even before designs were completed or experiments conducted, the District Engineer indicated that, because of the climatic conditions and because of the labor situation, it appeared that it would be advisable to precut and prefabricate at a central point. A discussion indicated that if the job was equipped to take care of such an operation, it would be sufficiently equipped to take care of field erection and operation, and it was decided to lay out the job facilities and assemble the job equipment on the basis of such a prefabricated method of operation.

This required most careful estimates concerning timing, quantities of material, and the nature of the operations performed on this material, within these time schedules. The time period was analyzed. It was estimated that plans would be available to start actual construction operations, other than experimental activities and organizational activities, on or about the first of February. It was estimated that these initial operations would result in the production of a farmstead unit per day by the end of the month of February. It was estimated that, with this month's organization and experience, production could be stepped up during the first two weeks of March to reach the maximum planned tempo of two completed farmstead units per day. The necessary yard space, saw equipment, warehouse facilities, job facilities, and especially the necessary

storage facilities and trucking facilities were planned for on this basis.

It was estimated that one mill saw, one jointer, one band saw and one gasoline cut-off saw could be made to perform the essential mill operations. These were secured from surplus lists and installed. For the yard operations it was estimated that three gasoline cut-off saws would be necessary for house operations and at least two gasoline cut-off saws would be necessary for the barn and outbuilding operations. It is estimated that one concrete mixer would be sufficient fer yard precasting operations and one concrete mixer, easily transported in a truck, would be sufficient for field concrete operations. This was the essential yard equipment. Spray guns from the surplus list were secured for the purpose of priming prefabricated material. These arrived in very bad condition. Time and attention was spent in their repair but it was found that they were uneconomical in this windy territory.

The remaining item it was necessary to consider, initially, was motorized equipment. It was estimated that two bulldozers, graders, two "kitties" and at least 25 trucks of various types could be economically used on this project to produce the required results within the time limit. Actually, one "kitty" and 16 trucks of varying descriptions some of which were not usable, were secured. The inability to secure more trucks from surplus property and the decision of the District Engineer prohibiting the purchasing of new equipment as an unnecessary expense for this project created a problem which was solved by using equipment in double shifts and utilizing a third shift to keep it repaired for continuous schedule. One of the greatest on-site difficulties was the utilization of Treasury Procurement procedure, in attempting to keep fifteen worn-out trucks working on double shift without catastrophes, which would completely tie up the operations, occuring more than once a week.

It was necessary to consider this equipment with the analysis of the available surplus materials, because some of this material was trucked in on this equipment; some came in box cars, one end of which was occupied by equipment and the other end of which was filled with miscellaneous material. In some cases it arrived at the project in such a state that it was hard to tell where the equipment started and where the material ended. When a concrete mixer got loose in a car loaded with buckets of paint, both the paint and the mixer arrived at LaForge, eventually, but the paint

certainly wasn't usable, and fortunately the mixer was not needed.

The Construction Engineers had to wait for sufficient data from the designing personnel to enable them to estimate the type, quality and quantity of materials that would be required for the job; they had to wait for the District Engineer to make up his mind from study of the situation, and observation of experiments, etc., and issue an order establishing a definite engineering method to be used. During this time the Construction Engineering personnel were actively engaged in the preparation of data to enable them to properly man the project; in the assembly of this transferred equipment; and in the classification and analysis of these surplus materials.

Another important general consideration concerned mechanism employed to hire personnel, pay personnel and discharge personnel; to transfer, maintain, account for and dispose of equipment; and the procurement receipt issue, use and the accounting for materials. It was necessary for the construction personnel in charge, to carefully study the general situation on-site and determine the principles of control and the mechanisms of administration that were to be established. In many cases latitude of decision was limited by Governmental regulations not only of the Department of Agriculture, within which this work was being performed, but, also by the regulations of the Treasury Department, who handled all finances and all procurement activities; and, the regulations of the Labor Department, who handled all personnel activities. Certain decisions concerning the type of accounting systems to be employed, within the general limits imposed by the Treasury regulations, the class and nature of accounts and the operating methods to be employed in furnishing the basic data to these systems, had to be carefully analyzed and coordinated with the actual field and shop operations. The mechanisms decided upon and their methods of operation are described in detail in that section of this report dealing with Construction Administration.

There was another phase of general planning which occupied a great deal of time and attention on the part of the construction personnel during the initial phase of the operations. Three distinct types of money were being employed to construct this project. This money came from different Congressional appropriations and the mechanism of handling the money under each appropriation was specifically provided for by basic law. This resulted, for example, in being

able to employ personnel for a certain number of hours during a given month when they were paid with one class of money and having an entirely different arrangement so far as the number of hours was concerned, when they were paid from a different type of money. The specific problems encountered in this regard and some of the methods that had to be employed to properly utilize these funds are illustrated and described in detail in that section of this report dealing with Construction Administration.

Careful study was involved in the preparation of graphic tabular data outlining the amounts and types of money to be used, general phase of work for which this money was to be used and the time periods in which the same would be used. It is of considerable importance to appreciate the necessity of such activities in Governmental operations. While private operations often involve complicated financial and organization activities, once they have been accomplished, the necessity for continuous watchfulness of these items is generally negligible. In Governmental operations of a complicated nature, continual analysis and watchfulness on the part of the operating executives is essential. Monthly reports showing the financial status were essential to guide the District Engineer and his staff in basic policy decisions. These reports had to show the exact status of all funds at the disposal of the District Engineer and indicate not only those funds that had actually been expended, but, also those funds that were encumbered for future expenditures. In Governmental operations, sufficient funds must be encumbered prior to any financial transaction. If all of the funds so encumbered are not actually used, the official who encumbered them must process the necessary action to remove that encumbrance before he can use these funds for future operations. The District Engineer expected to utilize every available dollar and every available resource to complete this operation. The necessity for careful financial control was therefore an essential element of this particular activity.

An exhibit of such an analysis made in the last months of the operation is included in the conclusion to this report. An inspection of that section of the report dealing with costs, will indicate how all of these elements had to be coordinated within the costs system employed, as well as to maintain accurate financial control.

One of the most important specific operations undertaken by the Construction Personnel prior to actual operations was the organization and layout of the fabricating plant and construction headquarters. The preliminary drawings and

sketches prepared by the design personnel for estimating purposes were architectural sketches made for the general study of plan orientation, elevations and appearance. Study of these plans and sketches was essential for initial general takeoffs, preparation of total quantity lists of basic materials and the preparation of general time schedules within the control period of operations. Based upon these analysis, preliminary organization of men and equipment were planned and preliminary layouts of storage area, shop area, office facilities, etc., undertaken.

These initial studies were made on the assumption that this project would be built by field operations and that the total extent of shop operations would be confined to storage and precutting activities. The work in this respect was complicated by the decision of the District Engineer to experiment with prefabrication methods. The first experiment was to build the small 2-bedroom house and utilize same for office purposes during the construction period. The on-site construction personnel were directed to cooperate with the design personnel and erect this house by prefabricated methods. This was an almost impossible assignment, using only the preliminary sketched architectural drawings. Sketches were prepared on-site to illustrate the shop and field drawings, essential to a prefabricated operation. The initial experiment was conducted as described in the section on House Design.

One of the most interesting facts learned from this experiment was that a prefabrication operation could not be intelligently conducted using ordinary architectural plans. The best approach to this type of work would be to discard the architectural plans as such, and use a series of shop and field erection drawings, coordinated with the material and cost control activities, by a set of control drawings. Later, as the work was completed, these control drawings would serve as a basis of preparing a standard set of architectural drawings.

A reference to the report on house and barn design will indicate how the District Engineer and his engineering staff summarized this belief and issued instructions to the design personnel in accordance with this plan and program. The results obtained by the first experiment were so interesting that even before the completion of the second experimental buildings, the on-site construction personnel were seriously concerned with making necessary adjustments and changes to conduct this operation on a shop prefabrication basis.

The first and most important element in these adjustments was a careful analysis and redesign of the office, warehouse and storage areas, which would be used as a prefabricating shop area. Plate #130 shows the final results. The original decisions concerning the location of a construction office, warehouse, stock barns and possible shop operations were unduly influenced by the existence of a railroad siding and cotton gin and warehouse in LaForge. Before any further description of this operation is considered, it should be stated that the District Engineer and his entire staff, if they had this work to do over again, would select a site remote from this congested area of buildings, a dry area of vacant land adjacent to the railroad and accessible to roads, but, not cluttered up with existing buildings. This would have been feasible on this project because the railroad line itself was used only every other day and could be utilized as a siding without the expense of installing special facilities. The extent to which the area needs involved in this operation were underestimated can be best illustrated by the fact that the construction engineer, the Resident Engineer Inspector and the operations engineer of the District Engineer's staff concluded that the majority of the prefabricated operations could be performed in the cotton bale warehouse itself. This building, a warehouse 40' x 160', eventually proved to be entirely too small for the mill operations alone. It is hoped that any group of engineers faced with a similar problem may benefit by this experience and select an area not limited by space restrictions or building restrictions.

The District Engineer recognized certain of these inconsistencies and insisted that prior to the design of this area, a complete analysis be made concerning the time scheduling of the operation. This involved determining the location of stacks of raw materials that would be essential to keep the processing plant at full operation and in delivering materials to the field at the scheduled time and place. This analysis clearly indicated an insufficiency of the area chosen, unless the most careful utilization be made of every available foot of space and every available building facility. It was decided, as a result of these studies, that the shop operations for house construction could be kept separate from the shop operations for barn construction. This not only facilitated actual operations, but fitted in with cost and administrative control.

A triangular shaped piece of property was situated on approximately the center of the project area on a siding of

the Cotton Belt Railroad. The cotton gin itself, a cotton bale warehouse, machine house, two cotton seed storage buildings and a small 2-room general office and scale house existed on this land. The first step was to fence in the entire area with strong woven wire fencing. The only openings in this fence were at the apex of the triangle and along the railroad. The gate at the apex of the triangle was used for all deliveries to the field and for receiving materials delivered by truck.

The triangular area was divided in half by an imaginary line through the office building. Facing the apex of the triangular, all house production plant operations were confined to the left side of the buildings and all outbuilding production plant operations were confined to the right side of the existing buildings. Construction operations required three classes of material: Raw stock; pre-cut stock, and prefabricated sections, generally speaking. All shop operations required the same three classes of material. Some raw stock was manufactured direct into prefabricated sections. Pre-cut stock and in some cases prefabricated parts, such as louvres, window assemblies, etc., were assembled into their proper prefabricated sections.

PLATE 133

A general scheme was adopted to control the flow of this material. Raw material, from the freight cars, was unloaded into raw material piles, arranged in three sections. In one section was stocked that raw material which was shipped directly to the field such as shingles, brick flue tile, etc. It was essential that the location of this particular portion of the raw material be such that direct shipments to the field, or the loading of trucks which included this type of material as well as precut and prefabricated material, would not interfere with yard operations. This necessitated one of the most difficult studies in traffic management encountered in this layout.

PLATE 134

Raw material which would be used, without processing, in the manufacture of prefabricated sections had to be located where it could be assembled into these sections in conjunction with precut and prefabricated parts without interfering with either shop operations or traffic to the field.

PLATE 135

The third type of raw material which would be processed

into precut parts for either shipment direct to the field or for the processing into prefabricated sections, had to be located at a point most convenient, first, for the precutting operation, and secondly, in line either to go into prefabricated sections or to be diverted into direct field delivery.

Generally speaking, in both the house section and the outbuilding section it was found that the raw material utilized for direct field delivery had to be placed at the extreme ends of the raw stock pile; in other words at the angles of the triange farthest away from the central buildings. There were certain exceptions to this location which complicated a simple plan of operation. For example, paint and hardware had to be stored in buildings. Millwork, purchased in partial assembly, such as doors, etc., had to be stored in buildings and the only buildings were located in the center of the area. Therefore, it can be generally stated that that portion of the raw material that went direct to the field, which was not stored at the extreme ends of the receiving line, was stored at the center of the receiving material storage.

PLATE 136

Raw stock which was to be processed through the saws into precut stock, was stacked immediately between the line of saws and the railroad. That portion which, after processing was to be sent direct to the field was placed on the interior portion of the stacks. This shipment of precut material direct to the field followed the same traffic lines as the shipment of raw materials, such as doors, paint, etc., stored in the center of the plant.

That portion of the raw stock which was processed through the saws into precut stock, for utilization in further prefabrication, was therefore in the center of the raw stock stack. This placed it in line to move in a perpendicular manner through the saws to the precut stock pile and from the precut stock pile to the assembly jigs for prefabrication operations. Therefore, these jigs were, in general, located perpendicular to the center of the raw stock storage areas.

Immediately in prolongation of the assembly jigs was prepared an area for panel storage. The location and organization of this storage area was one of the most interesting operations in this layout. The house panel storage area was redesigned at least four times. It was planned to prime these panels while they were in storage. After field

operations commenced it became obvious that duplicate storage racks should be provided for each prefabricated section so that one rack could be utilized for receiving of the sections, priming of the sections and storing of them during the drying process, while the other rack was being cleared by shipment to the field.

It became obvious during the first operations that the arrangement of duckwalks, loading ramps, etc., presented a very important part in the efficiency of this operation. Duckwalks were placed between the two panel racks, one end leading to the loading ramp and the other end to the assembly jig.

PLATE 140

Assembled panels were lifted from the assembly jig, slid on the duckwalks in a vertical position to the proper panel rack, and were primed and stored in a vertical position in one day. The next day the priming coat, having dried, these panels were returned to the duckwalk, still in a vertical

PLATE 141 & 142

position, slid to the loading ramp, up the loading ramp on to the truck in the order outlined for the loading process.

PLATE 143

Having arranged for the major operations, so far as location and direction were concerned, the necessity of finding locations for certain specific operations, such as the precasting of piers· the precasting of privy assemblies and later fitting in of operations not originally planned for, such as the prefabrication of porches; the prefabrication of gates, the prefabrication of portions of the food storage assemblies; the prefabrication of privies, etc., complicated this problem.

Some of these operations presented problems. In order to establish a prefabricating plant for piers and privy slab assemblies, it was necessary to locate raw storage for the sand and gravel that would be used, for the cement that was essential and for the water that was necessary not only in the fabrication operations, but also in the curing operations of the drying yard. These operations had to be on an extensive scale in order to be economical and this required a considerable amount of space for forms, during

the setting process, for other forms being cleaned and stored after the piers and slabs had been removed and for curing and storage yards. The sketch illustrates how these special operations were sandwiched in; the precasting plant being in the center of the operations, porches, privies, etc., being out of order on the far extreme end of the house operations.

In traffic arrangements, probably the major headaches were encountered. Provisions were made in the initial layout plans for simple solutions of the problems of traffic, that is, for loading a truck with prefabricated house panels, or for loading with prefabricated barn panels. When the real problem was presented a truck had to pick up a certain percentage of raw material, a certain percentage of precut material and certain elements of prefabricated material to go in the house. The raw material and prefabricated material had to be loaded from two to three different locations in the yard. It was a complicating procedure to route this truck to each of these loading points in such a manner that the load would be placed on the truck so that it could be unloaded in the proper sequence in the field. Early in these operations, the necessity of absolutely rigid discipline and control became apparent. Time was devoted, by the construction engineer and his staff, in carefully computing, not only what should be put on transport loads, but how it should be loaded in order to enable the unloading process to be properly accomplished.

The other factor of importance in studying the transport system was proper timing. Incidentally, the necessity for this rigid control of quantity, quality and timing of transportation proved to be one of the greatest assets in securing accurate cost control for the project. The discipline, essential in the routing of trucks, so that too many trucks would not be in the yard at one time, congesting traffic conditions, loading conditions, etc., was also essential to assure the arrival of materials on-site in the proper sequence for unloading and utilization without field storage. This discipline was facilitated by using only one delivery gate at the apex of the triangle. This gate was controlled by a guard who acted as a dispatcher and timer of transportation, in accordance with schedules worked out by the construction engineer.

When the entire problem of organization of this area for shop operations is considered, perhaps the most difficult single problem to properly coordinate was the proper use of available warehouse space. There was a continuous conflict between the desire to utilize warehouse space for

shop operations, to protect against the inclement weather, and to utilize the same space for storage activities either of received materials and equipment or of processed materials.

PLATE 144

The first and most important factor to be considered was the mill function. These mill operations had to be scheduled to utilize limited equipment, limited space and provide facilities both for the storage of raw material used in the mill and for the storage of finished material completed in the mill; and at the same time be performed in a manner adequate to supply these important elements to the proper shop prefabrication or field operations.

PLATE 145

The most important of these mill operations consisted of door and window frame construction, louvres, kitchen cabinet and sink assemblies, window and door screens, privy seats and lids, and food storage doors.

PLATE 146

Limited power facilities forced the use of gasoline saw equipment saving the available power (when the electric lights were off), for the operation of a small band saw, a planer, joiner and electric drill. The utilization of a gasoline saw in an old cotton bale warehouse involved fire risks that required constant supervision and caused constant anxiety.

PLATE 147

The space within these buildings was so limited that it was necessary to store materials such as flooring, doors, window assemblies, mouldings, nails and hardware assemblies in the most careful and economical manner. Schedules for deliveries of such material were made, in quantities that would not overload the available storage facilities or interfere with the necessary mill operations.

These operations were carried on during the rainy season in this territory. When the rain ceased, the winds began to blow and certain features were complicated by wind and dust. All operations, with the exception of the mill operations, were carried on in the open and provisions were made to protect them as far as possible by the use of

temporary canvas shelters.

There were a number of additional factors that had to be carefully considered. Provisions had to be made for proper storage of gasoline and oil, storage of transport equipment and certain field repair facilities such as greasing rack had to be provided. Three wells had to be drilled; one for utilization of office personnel and one at each angle of the triangle to supply drinking facilities for labor. A fourth well was later necessary in the center of the project to provide separate facilities for colored employees. Three temporary privies were installed to service the office personnel and the workmen; one for colored employees and one for white.

Office space was utilized as found, with the exception of the additional building constructed for experimental purposes and used during construction for office space.

One of the major problems of safety and fire prevention concerned the operations at the fabricating plant. Due to the congestion of materials and equipment in this confined area and the utilization of cotton warehouse buildings, every precaution had to be exercised both for fire prevention and accident prevention. With no forced water system, the establishing of these precautions were in many cases difficult and expensive. One isolated storage building, fortunately used only for dead storage, burned during operations, demonstrating the necessity for these excessive precautions. At the very outset of these operations, every reasonable precaution was taken to make a safe job for workmen. Special scaffolding was constructed for field operation of the most approved pattern. Gin poles, ramps, etc., were utilized to eliminate the necessity for heavy lifting. All machinery and machine operations were carefully inspected to see that safety guards, goggles, etc., were not only available, but were intelligently and properly used. First aid stations and first aid facilities were not only established but arrangements were made to acquaint men with their use and the necessity for prompt attention to even the most minor of injuries. The labor employed on this job could not be classified as construction labor. It became construction labor due to necessity and was unfamiliar with tools and construction process. These excessive safety regulations were essential.

The results obtained by this careful planning on the part of the construction engineers and their continuous supervision is evidenced by the fact that there were approximately 150 injuries reported and treated on this project,

and only one of these was at all serious. The others were cases that in many construction operations, where this careful attention was not directed to this item, would never have reached the reports at all. In the particular serious case - hernia - there is grave doubt that the injury was contracted on the project. Fellow workmen were very definite in their assertions that the particular employee came to the project with the hernia. The mechansim for handling this type of work is more fully described in the section of this report on Administration.

The second phase of actual construction work on the project was occupied with the test buildings of prefabricated houses and barns and field erected houses and barns, for the purpose of comparing methods both as to quality and cost; from the construction engineering point of view this was extremely difficult. Prefabrication operations used only sketched architectural drawings. Details, shop and field drawings were not available during these tests. The sketches used in place of such drawings served as a testing laboratory for the construction engineer as well as the design personnel to indicate what drawings, specifications, material lists and definite instructions were needed. The necessity of issuing definite instructions for an operation of this nature, when utilizing labor of the qualification available at Southeast Missouri, was emphasized.

Production orders, that would be necessary only in the sketchiest fashion to trained, skilled carpenters, had to be worked out in detail, outlining not only what was to be done, when and where it was to be done, but, also giving complete instructions of how it was to be done. The particular operations were described and an estimated maximum time limit that should be utilized in performing this operation was indicated. All equipment was detailed and wherever necessary, instructions of how this equipment was to be used, was included. All material, was detailed, both as to quality and quantity. It was soon apparent that for each production order a shop or field drawing illustrating what was to be done and how it was to be done, was of assistance.

Complete schedules, indicating when and where this work was to be done had to be worked out, carefully coordinated, not only for entire operations, but for the operations of each particular crew organized to do specific parts of this work. In other words the construction engineer and his staff utilized the design personnel to illustrate their orders and definitely supplied every man on this job either

individually or through his group leader, concise and complete instructions of what to do, how to do it, where to do it and when to do it. This constitutes the fundamentals of a complete production order, whether it be to build a complete house or to fabricate one small item that goes into a barn. Any element of such an order can be left out only because the skill and experience of the employee is depended upon to supply the elements missed.

The initiating of these orders, the coordinating of each separate function not only with all other related functions, but also with the design and the organizing and fitting these operations into a definite time schedule, was a major function of the construction engineer in charge of these operations. The results obtained were controlled and recorded through the cost system operated by his administrative section.

The first real data on which the organization of the job was based, came from the analysis of the results and methods developed during the construction of the test houses and test barns. The outline of the operations has been given in the design section. So much difficulty was experienced in costing the precut house that definite cost data could not be secured in time for a comparison. It was obvious, however, that so far as man-hours were concerned the prefabricated house certainly did not exceed that of the field erected house. The field erection of the precut house definitely required a higher type of skilled labor.

It was evident that if equal quantity of labor was required, the precut house was definitely more expensive and more difficult in quality of labor required. It was also obvious that better and apparently less expensive supervision of labor operations was possible in the prefabrication methods. Better control by careful scheduling of operations, of crews, of material deliveries and utilization of equipment, could be obtained through the prefabrication methods. It appeared that there would be less waste.

On the barn construction work, a very amusing incident occurred. A local foreman, with no construction experience beyond that gained in the local area, mostly on engineering construction rather than farm structures, was in charge of this work. On the first preliminary barn put up to study prefabrication methods, he assisted in the erection. Given the job of field erection from precut material on the second barn he laid out all the precut material on the ground and built it into panels which he then erected

in a manner somewhat similar to that planned for the prefabrication operation. After the precut barn was erected the same foreman and the same crew constructed the prefabricated barn from which some very definite comparative results were secured. Costs were much easier to keep and the prefabricated structure had a definite advantage of 48 man-hours over the precut field erection method of construction. Certain features, on which prefabrication was attempted, such as floors, proved to be of doubtful economy. On the other hand the prefabrication of stall feed boxes and other interior fixtures showed a definite advantage.

The quality of construction was carefully inspected by the District Engineer and his staff. It was a concensus of opinion that the quality of construction in the prefabricated houses was in all ways equal to that obtained in the field erection house. In the case of the barn it was the concensus of opinion that the prefabricated barn showed a better quality of construction. As a result of these experimental buildings, the construction engineer and his staff obtained very material amounts of data concerning the proper size of crews; the proper scheduling and sequence of work; the proper loading and delivery of materials, especially the necessity of controlling the method of unloading material and placing it on-site available for use, and a conception of the proper timing of each operation.

After the District Engineer made his decision and ordered the entire operation to be designed and built by prefabricated methods, the construction engineer and his staff, assisted by the design personnel, were in a position to organize, in a detailed manner, each specific operation in accordance with the preliminary plans and this experience data. The first and most pressing problem was to immediately organize the yard plant and get it into full speed operation to provide sufficient inventory to furnish complete houses, as soon as the field erection crews were organized for field operations. The tempo of this production plant had to be established sufficiently high to not only service the field currently, but to always maintain a sufficient stock so that the field operations could be conducted on an even schedule.

The first principle that must be observed in working out such an operation, is to gauge its tempo by the slowest and most difficult element involved. At this point it may be very interesting to note the continuous problem of

timing which confronted the construction engineer. He did not allow at any period, sufficiently for the increase in efficiency of these operations, as the men became more accustomed to their work and as the various elements began to work more smoothly in relation to each other. Consequently, in the initial stages, the plant operations, scheduled by best judgment and data available, outran schedules and the limited storage space became very congested. Later, as the field erection group became more efficient in their operations, they not only caught up with the production plant, but because of transportation and material delivery difficulties, experienced by the production plant, actually forced temporary shutdown in field operations, due to their developed efficiency. These results were obtained with labor who, outside of the superintendent, the supervising foreman and one or two men in the mill doing special cabinet work, could not have been classified by even the most liberal labor union standards as carpenters, second-class carpenters or apprentices. All men, who could in any way classify as better than apprentice carpenters, were so badly needed in the field erection crews that if one was developed or by any chance found his way into the shop operations, he was immediately transferred to the field.

The first job in organizing the yard operations was to design and construct necessary templates and assembly jigs for the operations. The sketches prepared during the experimental building and the temporary jigs and templates prepared at this time, served as a pattern and guide for this construction. Everything was kept as simple as possible. All lumber used to make tables and assembly jigs was scheduled to be salvaged and utilized for actual construction in the field, in the last units. The assembly platforms and tables were constructed of a size that were utilized for interior barn partitions. Generally speaking these jigs consisted of a table set on "horses" at a height which made it most convenient for the workmen. These jigs and framing tables were arranged in the sequence of operations in the most convenient location between the line of precut stacks and the storage racks for completed prefabricated assemblies.

In the assembly of wall panels a jig with drop leaf stud spaces was designed to frame rough members of studs, plates, etc. When these members were in place, door and window bucks, previously assembled in an adjacent jig, were laid in place, and the entire wall panel frame was stacked on finishing tables. This framing operation was simple and

accurate, requiring no measuring or squaring and no interpretation of drawings. The placing of each member accurately determined the placing of others. Such an operation is easily and quickly learned by inexperienced and unskilled labor.

Finishing tables were large enough to take two house panels at a time. These tables were equipped with templates, arranged to exact dimensions, which automatically tested panels for square and alignment. The templates on these finishing tables were equipped with measured and adjusted gauges, consisting of a piece of 1 x 2 hinged to the finishing table in such a manner that it would accurately align the siding. Saw cuts in the 1 x 2 were used to establish gauge marks. Every item of the construction of templates, gauges, jigs and tables, was made in this simple manner.

It was necessary to establish a jig for the construction of wall panels for houses, window and door bucks, roof trusses, gable ends, panels which became roofs of porches and floors of porches.

PLATE 148

One of the cleverest jigs was designed to fabricate the so-called "B" nailers, and well demonstrates the simplicity of properly coordinated shop fabrication methods. A box was made up 16' long with spacers every 2' to represent the width of ceiling joist material. The workmen dropped the precut nailer blocks into the spaces thus formed, put on the 2 x 4 top plate of the length required and nailed through at points marked on the box. These nails were driven diagonally, thereby creating the maximum utility of this nailer for the purpose intended. That is, when the ceiling panels were nailed to the nailer, all of the downward weight stresses were exerted at right angle to the nails rather than parallel to the nails, thereby establishing the maximum nail strength in this particular piece. This is described in some detail to illustrate refinements in quality of construction possible with unskilled workmen, when a carefully designed and carefully specified method of prefabrication is used.

PLATE 149

After the "B" nailer was thus completed it was simply lifted out of the box and stacked and the operation was complete.

PLATE 150

Even more complete jig and framing tables were utilized for barn and outbuilding prefabrication. With the exception of the roofing material, roof lath and girders, every element of the barn was prefabricated in the shop. The jig and framing tables utilized for these operations were in general similar to the ones used for house panel construction, but the operations were more complete. Door openings were completely sided over hinges and door batten properly placed, and the door cut out of the panel, ready to be utilized as a barn door. In order to simplify transportation, the cutting of these doors were only partly completed until the panel was actually erected in the field. Some extremely clever jig and template work was developed in the building of panels requiring spacing of materials, such as corn cribs sections, etc.

All exterior bearing walls of the house were made up in panels. There were ten sizes of panels; eight, 12' long and two, 8' long. When the construction of the 2-bedroom houses was discontinued, this total was reduced to 8 different panels.

PLATE 151

Wall panels were prefabricated in the following manner. All material was moved from the raw material stacks, through gasoline cut-off saws, established in a line parallel to the raw material storage, precut, marked with the required symbol and placed in carefully located and designated stacks. The studs and plates wereassembled from these stacks into a jig that automatically aligned them to square.

PLATE 152

One stud was left out in the space where an opening occurred and into this was fitted a door or window buck which had already been fabricated on an adjoining jig. Two of these frames were placed on a platform jig equipped with templates to align them automatically to square.

PLATE 153

Asphalt building paper was then nailed on. The paper was then cut between the two panels.

PLATE 154

Window and door frames were laid loosely in place. Door

frames were fitted in the field because the bottom plate was used to strengthen the panel temporarily and could not be cut out until the panel was in place in the house.

PLATE 155

The gauges for aligning the siding were raised into place lining up the bottom edge of each piece of siding. The window frame was then nailed in place and lined according to the gauges.

PLATE 156

This siding was all precut. Blocking pieces were nailed to each stud to block out a frieze board to lap over the siding and served as a frame for the header casing for the windows. Originally an attempt was made to fit this frieze board to this panel in the shop. This was found impractical because of the variance in width of the 1 x 10" boards used for this frieze.

PLATE 157

The siding was held up from the bottom of the panel about a half width of siding so that the joint between the floor platform and

PLATE 158

the lower plate of the panel would be well covered, when the field application of sheathing paper and siding finish was put on the girders. The siding was also held back from the ends of the panels by a width of half stud. This allowed a filler strip of building paper and sub-batten of 1 x 2 and batten of 1 x 6 to be placed in the field, to completely seal the joint between each panel.

PLATE 159

The window casings were nailed on the panel, ready for stacking and painting. The window and door inserts were made as a separate fabricating job from the wall framing. These windows and doors were designed to occur in the exact center of a two-stud bay so that the framing of each door insert and each window insert was similar and could be made up in a simple jig.

PLATE 160

The roof trusses and gable ends were made up from precut

2 x 6 rafters and 2 x 4 ceiling joists, nailed together in a simple triangular shaped jig, equipped with templates so spaced that each member would be fitted exactly as called for in the design. By using the same jig and templates, an exact alignment of all roof members was automatically obtained.

PLATE 161

The necessity of care in nailing for these roof trusses has been pointed out, as the strength of the truss was largely determined by the sheer stress developed by the nails at the junction points.

PLATE 162

This was another instance where the direction of each nail driven could be planned and determined.

PLATE 165

In the construction of the gable end panels, a bottom plate of 2 x 6 material in 12' lengths, scabbed in the center, was used. This served not only as a plate to hold the crippled studs, but, also as a ceiling nailer for interior ceiling finish. Crippled studs were fastened to this plate on 2-foot centers, designed to be exactly above those in the wall panel. The center stud was left out for inserting of the louvre assembly. This louvre assembly was made up in a rectangular shape, to avoid mitre cutting. The crippled studs were square cut, as was the siding. All studs and siding were precut.

PLATE 166

In place of a top plate, standard 2 x 6 rafters were used, flat against the inside face of the studs and nailed to the plate at the ends. This gave a triangular construction similar to a truss and required a minimum of care in fitting.

PLATE 167

As in the case of wall panels, the precut siding was first fitted under the louvre. It was carefully scheduled to be held away from the bottom sufficiently to allow the bottom siding board to be loose nailed for fitting in the field erection, above a drip mold which carried across the top of the band of the frieze board.

PLATE 168

This gable end was designed to be finished in the field by application of a double rake board of 1 x 8" material, which served to cover the square ends of the siding and studs and made a triangular shape of the rectangular louvre without losing the efficiency of its ventilation.

Here again an attempt was made originally to apply these rake boards in the shop but it was found that the close fit necessary could be done more effectively as a field operation.

PLATE 169

The porch floors and the girder and joist system were completely assembled in a jig and bridged by blocking. This assembly was delivered to the field as a single panel.

PLATE 170

The porch roof was completely assembled in a jig and was delivered to the field as a panel.

PLATE 171

The deck was completely roofed, in the jig, allowing sufficient material to enable it to be placed either beneath the cornice of the eaves or against the frieze on the gable ends and furnish its own flashing.

PLATE 172

Ordinarily door and window frames, kitchen cabinet assemblies, etc., are purchased as millwork, in any building operation. The time for completing this work was definitely set and limited. Utilizing the Procurement service of the Treasury Department with its attendant difficulties, made it impossible to purchase this material in normal fashion and secure deliveries that would not completely disrupt the construction schedule. It was necessary to set up a mill and fabricate these items on-site. This same mill was utilized to fabricate the louvre assemblies, the door and window screens, privy seats and lids, doors for food storage assemblies, etc., requiring millwork accuracy.

This operation was carried on in a standard manner and required the use of the most skilled mechanics in the shop

operation.

The actual operations of the yard plant at Southeast Missouri when operations reached a stage of full efficiency were as follows: All operations were under the direct supervision of the Yard Superintendent who supervised the yard plant, delivery, and receiving operations. The Yard Superintendent was assisted by a Warehouse Foreman. This Warehouse Foreman handled all the store house and warehouse facilities and also handled all transportation activities. His permanent force consisted of a tool clerk, mechanic, truck driver, and two laborers, in addition to the personnel assigned to specific transportation facilities, loading and unloading facilities, etc., which operated under his direction.

PLATE 174

The Mill Foreman, assisted by a timekeeper and checker, operated the mill. He had two First Class Carpenters working on louvres who turned out at peak production ten (10) per day. Two first class carpenters worked on door frames and turned out at peak production fifteen (15) per day. Two first class Carpenters worked on door screens. As a matter of fact, these operations were conducted interchangeably. The same two carpenters worked for a period on louvres, for another period on door frames, and another period on door screens. Six first class Carpenters working on cabinets, at a peak production, turned out six (6) per day. These men at other times worked on window frames and turned out 16 per day at peak production. Five first class Carpenters worked on window screens and privy seats and turned out at a rate of 15 per day.

In addition to these first class carpenters, the Mill Foreman had the necessary labor service unit to keep them supplied with material, to stack and handle stock, and the necessary operative personnel to handle gasoline driven saw, planer, jointer, and drill.

One Foreman handled the plant operations for houses and outbuildings. This Foreman was assisted by a timekeeper checker handling material, deliveries, and a timekeeper checker who handled prefabrication costs and operations. These outbuildings consisted of food storages, porches and privy operations. Generally speaking, the work consisted of two classes: precutting and prefabrication.

PLATE 175

Three first class carpenters, two second class carpenters, and five laborers were used in the precut plant for houses. The same organization, when their house work was completed, precut privies, food storages, gates and porch materials. This crew would turn out two complete houses per day, five privies per day, and ten porches per day.

PLATE 176, 177, 178, 179, 180

The prefabrication crew consisted of twelve first class carpenters, two second class carpenters and the necessary labor personnel to service the organization. This crew was capable of completing prefabrication sufficient for two complete houses per day, eight complete porches per day and five complete privies per day, when working at full efficiency.

PLATE 181

The Barn Plant Foreman had an organization consisting of a precutting group and a prefabrication group. Two first class carpenters and six laborers handled this precutting and attained a rate of 2 complete barns per day. Eight first class carpenters and seven second class carpenters handled the prefabricating, which attained a rate of 2 complete barns per day.

PLATE 182

Reference in this section to first class carpenters means that these men were classified as such for payroll purposes. None of these men could have been classified above an apprentice carpenter by even the most liberal labor rulings. In this particular instance, they were entitled to this rating because the work they performed was equal to that of a first class carpenter. Again, if any of these men showed evidence of being a real first class carpenter, he was shifted to field work where real carpenters were needed.

PLATE 183

The General Labor Foreman, with an assistant, handled all labor service works needed in the shop organization. He unloaded all cars, stacked all raw materials.

PLATE 184

He performed all service functions for keeping equipment

in shape. He furnished loading crews for loading of all outgoing material.

PLATE 185

In between these specific functional operations, he operated the precasting plant which precast all house and barn piers and all privy slab assemblies.

PLATE 186

Naturally this organization had to be a flexible organization, and needed careful supervision and direction.

PLATE 187

When material arrived, it had to be unloaded and properly stacked. When bad weather held up field operations, this crew had to be shifted to yard operations that took the place of their unloading and shipping activities. When cars were spotted, everything but essential delivery activities was stopped in order to unload these cars, stack the materials and properly use the limited stacking facilities. Some of the records set by this crew included casting 80 piers per day with three laborers, casting 90 barn piers with three laborers, and casting three complete privy assemblies with three laborers.

PLATE 188

The Paint Foreman performed various functions as the occasion demanded, in his yard operations. He maintained approximately three or four painters on yard duty to prime all prefabricated assemblies. Twelve painters could prime six barn panels per day; three painters prime 30 house panels per day, and one painter prime three privies per day. Three painters put out 24 gates per day.

PLATE 189

The Labor Foreman and the Paint Foreman operated both as a yard foreman and as a field foreman. While they were working in the yard, their operations being under the supervision of the Yard Superintendent; their activities and operations in the field were under the supervision of the Field Superintendent. This dual arrangement was necessary to enable the economical utilization of both, men, material and equipment. Certain men were shifted from field operations to yard operations to meet yard emergencies. Conversely, yard men were shifted to field operations

to meet field emergencies.

In addition to these specific crews, the watchmen, guards, and janitors essential to operations on a 24-hour basis were assigned to the direct supervision of the Yard Superintendent.

The one point of direct contact between field operations and yard operations was involved in the loading and delivery activities. While this was under the direct supervision of the Yard Superintendent, it was, of course, of basic importance to the Field Superintendent. Very careful planning was essential to work out these problems. So far as possible, all transportation was made by standard loads. Generally speaking, these standard loads were arranged as follows, although these descriptions were subject to adjustments, either to improve the service or to meet special situations:

Load No. 1 consisted of girders, bridging and sub-floors. Load No. 2 consisted of wall panels, braces and blocks. All bridging, bracing and blocking was carefully figured and precut and sent to the field in bundles. Certain details of organization such as adding one or two extra items such as these to each load, made up some of the initial adjustments.

Load 3 consisted of roof braces, A and B nailers, roofing, nails, etc. Load 4 consisted of windows, doors, interior and exterior finish, etc. Load 5 consisted of porch floor assemblies, and porch roof panels. Load 6 consisted of interior wall and partition lining, insulation board for ceiling finish, etc. Load 7 consisted of flooring, interior doors, painting, paper, windbracing, etc. Load 8 consisted of the complete kitchen cabinet cases and miscellaneous finishing items.

The labor crew which was charged with the field operation of setting piers, arranged for its own transportation and carried with it not only the necessary tools and equipment, material and supplies involved in the setting of piers, but also the piers themselves. This was essential because the entire operation was conducted at one time, and eliminated the necessity of maintaining any field stores of sand, gravel, cement, etc.

The field operations were arranged in a logical sequence. The labor crew performed the preparation and clearing of sites. Field Engineering crews established grading levels

and set batter boards. Another section of the labor crew, completely equipped, arrived on the site, and set all house and barn piers at one operation. This crew immediately set out for the next site to repeat the operations. During this operation, the transportation facilities delivered all of the material necessary for building the floor assembly for the house.

A special crew arrived at a scheduled time (figured to allow a satisfactory set of the piers) and completely erected the floor assembly in the field from the material delivered. (See Load 1).

Load 2 was scheduled to arrive when the floor assembly was completed. The unloading crew accompanying the truck unloaded and stacked the panels in a pre-determined sequence, at s specified location near the center of the floor assembly.

Load 3, and Loads 4 and 5 were delivered to the site at this same time, and were carefully unloaded at scheduled spots in relation to the house location. The erection crew was scheduled to arrive after this complete delivery was accomplished. This crew was completely organized and equipped to handle the entire erection of the house, including the placing of wall panels, gable ends, roof trusses, and roof lath. When these operations were completed, this erection crew moved to the next job.

Specialty crews arrived to build the chimneys, roof the house, put on the exterior trim, and to set the windows and doors. The same crews set the porches and finished the exterior of the house. The crews handling the interior finishing of the house and painting of the house generally arrived simultaneously. While the exterior paint was being applied, the interior finish crews placed the ceiling in position, laid the floors, and after this had been accomplished, built all of the partitions. They hung the interior doors, set in kitchen cabinets and finished all the exterior and partition walls. They applied all necessary inside trim.

A different crew handled the interior painting from the exterior crew, although operating under the same Foreman. As soon as the exterior painting crew and the interior finish crew left the house, the finishing crew consisting primarily of the painters and the necessary labor personnel to clean up, arrived. This crew was charged with the removing of any scrap material or equipment remaining on the site.

It was originally planned to maintain this crew set-up and the sequence of work on an absolute basis; and this assignment of crews moving from one specific job to another was originally laid out along these lines. It was later adjusted so that the carpenter crew, that arrived to build the platform actually moved on to build an adjacent platform, but returned to erect the house. The exterior painting crew, in final stages, not only applied the exterior paint but as soon as the interior finishing crew left the house, proceeded to take care of the interior painting finish. These refinements were possible in some cases only after the timing had been carefully worked out so that the crews performed the proper functions in proper sequence and got out of each other's ways on-site. In a larger operation, it would probably be wise to maintain the first definite crew layout and assignment rather than to duplicate operations by the same crew.

All of the field operations were under the general supervision of the Field Superintendent. He was assisted by a Foreman, in charge of all of the framing of the house. The various operations involved have been outlined for the sub-crew operations, and are clearly illustrated in the general personnel chart.

This House Foreman was assisted by one timekeeper and had a Ford pick-up truck assigned for his particular use. He cooperated closely with the House Foreman charged with interior finish. As a matter of fact, these Foremen used the same timekeeper and the same Ford pick-up. Plate 299 clearly outlines the sub-crews for the finishing operations.

The Paint Foreman was assisted by a timekeeper and had a Ford pick-up assigned for his use. In addition to the Ford pick-up certain major deliveries were made direct from the plant operations. The sequence of painting operations and the operating of the sub-crews and their accomplishment are clearly outlined in Plate 299 .

The General Labor Foreman utilized a pick-up truck and operated a number of field operations all of which were handled by sub-foremen. The operations involved in setting of house and barn piers have been described. He also had charge of all fencing operations; and, the installation of all well assemblies. He set all privies. He constructed the roads, drives and culverts incident to the farmstead itself. He was also charged with all clean-up activities after completion of the farmstead. The make-up of his particular crews and the basic equipment needed as

well as the average results obtained are set forth clearly in Plate 299 .

The Barn Foreman maintained, at his peak, six complete erection crews. As shown by Plate 299 , it took three days for each crew to complete the erection of a barn. These six crews operating in parallel, it was necessary to maintain an average delivery of two completed barns per day. This same set of crews, after completing the barn erections, were adjusted to include the necessary equipment and labor service to erect all of the food storage units on the project. This necessitated the utilization of field concrete equipment. These crews placed all well platforms at that time. The organization of the Barn Foreman's operations is clearly set forth in Plate 299 .

The first construction operation for the house was the setting of the piers. After the houses had been staked out and batter boards erected, pier crews arrived on the job to set the precast piers. Excavations were dug for field footings and piers placed in position. There were three parallel rows of piers of five to a row with two for each porch making a total of 17. These piers were two-man size weighing approximately 120# each and were easily adjusted in place after the excavation had been partially filled with concrete. It was necessary to have the tops of these piers exactly level to avoid excessive shimming and to have the anchor straps turned properly. Full details were included on the drawings. Chimney pier of concrete block with poured concrete footing, and concrete block porch step footings were also executed by this crew.

PLATES 201, 202, 203, 204

Two crews were each composed of a working foreman, a truck driver, and four common laborers; each completed two units a day.

PLATES 205, 206, 207, 208

Girders, joists, and bridging were delivered precut and marked ready for quick assembly. Girders with the ledger boards were assembled first, then joists were laid, working from the center out. Joists 2'-0" on center were then nailed in place and the frame checked for square. Bridging and sub-floor were then nailed down, and the operation

of this crew was complete. A crew of one first class carpenter, five second class carpenters, and one laborer took approximately three hours for the job.

PLATES 209, 210, 211, 212, 213, 214, 215

Wall panels, gable ends and trusses were on the job when the erection crew arrived. The wall panels, arranged in sequence of erection, were braced in a vertical position in the center of the platform, while the trusses and gable ends were stacked in convenient positions just off the platform. A corner panel was used as a starter panel and erection continued in one direction until the exterior perimeter was enclosed. As each panel was slid into position, it was squared, plumbed, and braced, but only temporarily nailed to the platform. When all panels were in place, they were checked for accuracy of alignment and correctness of position before being finish nailed.

PLATES 216, 217, 218, 219, 220, 221, 222,
223, 224, 225, 226

A gin pole, with braced bracket and block and tackle was next raised and braced to hoist the gable ends in place.

PLATES 227, 228, 229, 230

Truss rafters were next raised in place and nailed to the top wall plate. This operation was executed without the use of scaffolding in the following manner. Three men carried the truss rafter in through the door and raised it up to two men sitting on the top plates. The lead-off man rode the bottom chord of trusses already erected and, by means of a marked roof lath, spaced each truss at the top as it was erected. The men on the plates spaced the bottoms, by nailing the bottom chord directly over the stud centers of the wall below. There was no need for measuring and plumbing. The diamond bracing on the under side of the rafter trusses, putting on roof lath, laying the catwalk, and placing "A" and "B" ceiling board nailers completed the erection work.

PLATES 231, 232

This operation took approximately four hours for a crew of one first class carpenter, five second class carpenters, and one laborer under supervision of a foreman.

PLATE 233

A brick chimney 1' - 5" x 1' - 5" square with a single terra cotta flue tile $8\frac{1}{2}$" x $8\frac{1}{2}$" was the next operation in sequence of erection. It was built on the concrete block foundation prepared by the first crew and included setting two metal thimbles and flashing at the roof line. The chimney cap was corbelled and finished off with a cement wash leaving the flue tile projecting two inches. There was only a single chimney crew towards the latter part of construction owing to the scarcity of good brickmasons. This crew was composed of bricklayer and hod carrier and the operation required a full eight hour day. This brickmason was imported from ST. Louis, a hundred and fifty miles away.

PLATES 234, 235

The shingling operation was carried out next with a crew of two first class carpenters and one second class carpenter requiring approximately nine hours to complete the job including trimming ridge and placing the metal ridge roll. This operation was frequently speeded up by using two crews to each house, one on each slope of the roof. During the early stages of construction progress this job was not a complete operation owing to necessity for meshing this job with the one of laying metal decking over the porches. A re-design of the porch eliminating the necessity of flashing under the shingles and building the chimney before shingling, also eliminated complications.

PLATE 236

As soon as the prefabricated sections were in place, the chimney built and the roof shingled, the rest of the building schedule was more flexible. It was to this end that construction Engineers had influenced the design of the houses. Finish could be carried out on the interior or exterior or both at the same time. Porches could be added at almost any stage and actual progress not held up by lack of material or labor for a single key operation.

PLATES 237, 238, 239, 240, 241

Exterior trim was normally the next operation, however, and included setting frieze boards, rake boards, drip mold and junction between gable and panel and the wall panels below, siding cover over the girders, battens and cover boards at panel joints, soffit and quarter round

under eaves. It also included finish of porches, as porch panel erection was included in the work of prefabrication erection crew. This exterior finish crew consisted of six first class carpenters and the total time was approximately twelve hours.

PLATES 242, 243

A description of the operations of interior finish will explain a reason for the truss rafter system, other than enabling the building to be quickly enclosed and roofed. Ceilings and floors were laid as a complete operation before the partitions were put in, eliminating cutting and fitting. The ceiling of one inch insulation board in large sheets 4'-0" x 8'-0" was set. All cross nailers had been designed for. Side nailing was effected on the bottom chord of the trusses 2'-0" O.C. It was necessary to cut out two sheets for chimney and scuttle, but this was a standard cut for all houses and easily accomplished.

PLATES 244, 245

A through finish pine floor was laid over building paper. The interior lining of the walls and partitions was then nailed in place. This lining was of knotty pine boards 1 x 6 T. & G. with a "V" joint and was precut to standard length in the shop. Field cutting was necessary only at the sides of windows and doors and this could be roughly done as casings covered all joints.

PLATES 246, 247, 248, 249

This crew also set partition framing of 2 x 2 with diagonal wind bracing of 2 x 4 at all necessary points, interior and exterior doors, thresholds, window sash, all trim including base and ceiling mold of quarter round, and all screens and hardware. This crew was composed of six first class carpenters and the operation took approximately twenty hours.

PLATES 250, 251, 252, 253

Interior painting included two coats of casein paint on the ceiling and two coats of hot boiled linseed oil and turpentine on walls, trim and floors, and two coats of lead and oil on porches.

Exterior painting job was split between yard and field work in the following manner. All panels including gable

ends were primed in the yard. On the job, finish trim, etc., put on in the field operation was primed before a complete finish coat of lead and oil was put over all. The painting job will be completed with the third coat during the spring and summer of 1939 after the second coat has weathered properly. The Painting crews were composed of three painters and required approximately ten hours each for interior and exterior jobs.

PLATES 254, 255, 256, 257, 258

The barn operations in the field were segregated by crews and scheduled in a similar manner to the houses, but being of much simpler construction there were only three general operations. The piers for the barn were shorter by six inches than those for the houses but they were set in the same manner according to pier setting plans. There were also necessary two piers with dowels in the center for the foundation under two wood posts of the roof system.

The panel erection crews placed the girders and joists, laid the flooring of the corn crib, grain storage and hen house, and then erected all the prefabricated panels including mangers, partitions, etc. They completed the job with precut rafters, roof lath, battens, windows, doors, hardware, and corrugated matel roofing ready for prime and finish painting.

PLATES 259, 260, 261, 262, 263, 264, 265, 266, 267, 268

Panels for the barn were not prime painted in the shop because it was not convenient to handle these panels vertically either in transit or at the job. There were approximately twenty-seven different prefabricated sections and the most convenient manner of delivering them to the site was horizontally, one on top of the other in a trailer truck. They were arranged to be easily distributed at the site by driving the truck around the foundation and disposing each panel on the ground in its approximate location. Handled in this way, no prime painting in the shop was possible, so both coats were put on in the field.

FOOD STORAGES

Food Storage Units, at this Project, were not designed in the initial operations. Sufficient building experience and an analysis of costs was required before the District Engineer was in position to definitely order food storage construction.

This structure was needed to complete the home management efficiency of this project. It could be eliminated if it was found impossible to complete the more essential farmstead structures.

PLATE 269

The designs submitted were carefully analyzed by the Construction Engineer. The ground conditions at Southeast Missouri were thoroughly understood and appreciated by this time. With the approval of the District Engineer, the Construction Engineer decided to construct this structure with some variations in the design.

PLATE 270

The trace of the base of the food storage was established on the ground and excavations made, providing for a spread footing, approximately 6 inches deep and 18 inches wide, continuous under all walls. The excavated earth was levelled in the center of the trace and carefully tamped. The footings and floor of the structure were poured at one time, as a single monolithic slab.

PLATE 271

An attempt was made to completely prefabricate the roof, so that it could be transported, in total, to the field and placed on the completed wall structure. This was abandoned because of the excessive weight of the fabricated part and the fact that special equipment would be needed to place it in the field. The handling and special equipment would defeat speed or economy. Instead, small trusses and gable ends were prefabricated and erected in a manner similar to erection of house roofs, and all other materials precut in the field.

Care had to be exercised in the construction of the door.

This door was designed to serve the same purpose as an icebox door and had to be constructed with similar care. Because of this fact this operation was made a mill operation on this job.

The experimental building and the preparation of prefabricated parts for the construction of food storages, was scheduled at a time that would fit in with the major construction activities.

It was decided to pour footings and floors as a monolithic concrete structure; to utilize the same crews and equipment to pour the well slab platform; and, as a third operation pour the walls of the food storage structure.

The construction engineer organized this operation as a single crew, selected personnel which had been engaged in general in the erection and construction of barns, and utilized them for this purpose; the barn operations having been completed. In order to get within the time limit, it was necessary to schedule this operation sufficiently to complete five food storage units per day, when operations were undertaken.

The crew was divided into various sections. The first section consisted of the crew pouring the food storage footings and slab and the well platform slab. This crew consisted of a working foreman and four laborers equipped with the necessary hand tools, truck, and a half bag rubber-tired concrete mixer.

PLATE 271

After their operations were shaken down they would complete five foundations and slabs for the food storages and five well slabs per day.

All aggregates, such as sand and gravel were delivered by the vendor direct to the sites. Stakes establishing the location of the food storage had been placed and a supplemental stake properly indicated where aggregate material was to be delivered and stored by the vendor.

Cement was carried by the crew. The operation of this crew set the tempo for the entire operation. Upon arrival on the site they laid out their forms, excavated for footings, carefully tamped and cleared all ground surfaces. By the time this operation was completed, sufficient concrete was mixed to make an immediate monolithic pour.

PLATE 272

As soon as the pour was completed the crew picked up and moved on to the next job. In order to meet the time schedule, this crew was later increased sufficiently to operate in two sections; that is, one section prepared the ground, set the footing forms and left for the next job, while the second section poured concrete footings, floors, well platforms, cleaned up and then proceeded to next job. The necessity for making this increase was due to the very difficult weather conditions, which retarded progress anticipated by a very close time schedule.

PLATE 273

This crew stripped and cleaned forms ready for re-use at next job. A truck was fully utilized in servicing the operations; that is the delivery of cement, etc., in picking up and transporting forms from one job to the next, and in transporting the rubber-tired half-bag mixer and hand tools.

PLATE 274

The second section consisted of the personnel that set the forms for the monolithic pour for the side walls. This section operated in three crews in order to keep up the established tempo. Each crew consisted of two second-class carpenters, who were occupied half a day placing side-wall forms. These forms were carefully designed for this particular operation, utilizing some very clever waling arrangements and interior spreader arrangements. It may be of interest to know that the 8 original sets of forms carefully built out of matched flooring, carefully oiled, served to pour 103 complete units (1 being re-poured). Most of this material has been absorbed, since operations, in the construction of hog houses and machine sheds at the project; these structures being built by the homesteaders. This demonstrates the value of utilizing first-class material in form construction and careful maintenance of the forms during operations. The clever arrangements for the erection and stripping of these forms made rough usage unnecessary and unquestionably accounted for the long life of this particular item.

The third section consisted of two crews, who poured the monolithic walls. These crews operated in double shifts in order to utilize the single set of equipment. Each crew consisted of six laborers and a straw boss. The

crews were equipped with a truck, a two-bag mixer, and "A" framing scaffolding, two sets per structure including approach ramps and wheeling platform.

PLATE 275

The movable scaffold and wheeling platform was set up on the two sides of the structure, extending well beyond both ends, the ramp leading to the two-bag mixer. Concrete was transported by wheelbarrow, up the ramp to the wheeling platform. Two laborers dumped the wheelbarrow load in the side-wall form, while a third tamped and puddled this dumped concrete. The partial pour for the door end was easily executed from the wheeling platform on the side. The pour for the blank end was executed from both platforms by spading or puddling operations when necessary. The care with which this operation was supervised is evidenced by the fact that 102 structures were poured with no evidence of "honeycombing" in any of the concrete side-walls. The foreman set the bolts by template, in accordance with the plans, for fastening the roof plates to the walls. The forms were stripped by the three crews of carpenters who erected the same.

All material for completing the structure, that is, the door assembly and the roof materials, were delivered from the yard to the site at the proper time to meet the requirements of three crews of two second-class carpenters each, who completed two units per day.

PLATE 276

Inasmuch as this operation was completed after the house and barn had been finished and painted, painting crews had to return to the site in order to complete the painting of this structure.

No attempt was made by the construction personnel at this time to mound the food storages. In the initial plan this operation was to be performed by the homesteaders themselves. After completion of the major construction activities, the District Engineer's personnel returned to this project and completed this operation as an additional construction item, utilizing, as far as possible, project homesteaders to supply the necessary labor.

PRIVIES

The privy construction presented some interesting problems. The privy pit was located by the Land Planning Engineers, with other farmstead structures.

~~PLATE 280A~~

This pit was excavated by the labor section at a convenient time while working on the farmstead. This operation served as a standing order for the field labor crews so that when personnel was available, they could be put to work on this particular operation.

PLATE 281

The wood cribbing that lined the pit was made up of all scrap material available in the yard. These cribs were made up in quantities in early stages of the operations and were placed on-site about the project as quickly as possible.

PLATE 282

A labor crew would sometimes excavate the privy pit and set the privy crib weeks before the actual privy installation would be accomplished.

PLATE 283

The concrete floor slab and seat riser were precast in the yard in the same precasting plant that fabricated the house and barn piers. Again, this operation as previously described, served to be a standing order for the yard labor crews and was performed, generally speaking, whenever these labor crews were not occupied in unloading material, loading material, etc.

PLATE 284

This establishing of certain operations of this type as standing orders, plugged up the inaccuracies of the time and labor crew organization.

PLATE 285

One of the difficult problems was the loading of this concrete assembly in the yard, transporting it to the site, unloading it at the site and setting the assembly.

PLATE 286

Undoubtedly, special equipment could have been devised that would have greatly facilitated this operation. Due to the fill-in nature of this construction, however, and the fact that it was performed as a fill-in operation for the common labor crews, this equipment was never provided.

PLATE 287

A crew of ten men slid the assembly on to a flat bottom truck, loaded the ramps, went to the site, used the ramps to unload the assembly on-site and utilizing ten husky laborers, placed the assembly properly on-site. This crew became so skilled, and the flat topography of the country was such that they were able to back these trucks into position, adjust their unloading ramps in such a manner that when the privy assembly loaded with this thought in mind, was slid down the ramp, it was practically set in position.

PLATE 288

The privy itself and the privy seats and lids were all completely prefabricated in the yard. Again, when the labor crew and transportation equipment were available, these complete assemblies were carefully loaded by the labor crew, moved to the site, unloaded and set in position.

PLATE 289, 290

These privies were made exactly in accordance with the designs by the State Department of Health of the State of Missouri. As a matter of fact metal forms prepared in accordance with this design for use by the W.P.A. operations, were borrowed for these activities.

PLATE 291

The persons interested were so pleased with the results obtained and the efficiency of this operation that efforts were made and are still being made to extend this service to supply state-wide need, utilizing W.P.A., organization operating on a plan similar to that developed on this project for the purpose.

PLATE 292

There was a little werk by a carpenter crew for finishing this job. This crew adjusted the seat and cover assemblies, bolted the privy building to the floor slab and inserted the metal flue ventilator. After the entire operation was completed, the cleanup crew mounded the earth about the assembly and tamped it so that it would properly shed water away fro. the structure.

Because of the intermittent fill-in type of organization used for these operations, it is hard to definitely state what an organized crew could do in completely building such a structure, so far as time is concerned. It is our best judgment that a trained crew, organized in sections, such as the food storage crew, would be able to set and complete six privies a day.

The size of the crew and the type equipment used, etc., would have to be studied most carefully to establish the tempo for an extended operation of this type.

FENCING

On this Project fencing of the barnyard only was required. The barnyard was approximately square and enclosed the barn located approximately in the center of the square. The barnyard fence required about 30 yards of fencing and two field gates. The field gates were prefabricated in the yard, painted and were ready for installation.

Fence posts were bought in quantities and stored in the yard for delivery to the site as called for. The Treasury Procurement Office was faced with a problem in buying fence posts and operations were hindered and thrown out of schedule by failure of delivery of this particular item. When post material was purchased locally the local vendors utilized the services of the administrative personnel to take care of the unfamiliar Governmental procedure. The wire used was not standard because surplus wire was shipped into this project of different types and patterns, all suitable for this purpose. Some adjustment was involved whenever the pattern was changed.

Fencing operations were performed by one crew under a fencing foreman. This crew was equipped with a truck, which handled the delivery of its materials to the site and handled the transportation of men and equipment from site to site. The crews included two second-class carpenters, whose main functions were to hang the gates and to properly brace the four corner posts and gate sections. There were four laborers who dug the post holes, set the posts and stretched the wire. The wire stretching operation was given the personal attention of the fencing foreman.

It is believed that the barnyard fencing at the Southeast Missouri Project represents an extremely fine example of good fencing within controlled budget limits. This crew, operating as fully organized, was capable of fencing two complete units per day.

WELLS

There were 108 wells constructed on this project. Every well constructed on the project was a driven well. Due to the simplicity of design, it was not necessary to use the conventional well rig. An improvised well driving equipment consisted of an ordinary stake body truck and was equipped with such necessary tools as dies, cutters, pipe vises, etc. In addition to these necessary tools, this truck carried sand, cement, gravel, a day's supply of 10-foot lengths of drive pipe, sand points and a complete water pumping assembly, and a supply of lengths of 4-inch pipe used for the housing and driving tools. This truck also carried a post hole digger, a 2-inch soil auger with extended handle, special driving cap made of a 5-foot length of 4-inch standard pipe with one end closed and arranged to telescope over the drive pipe during the driving operation. Mixing water pails and a supply of chlorinated lime was also carried on the truck so that the well could be chlorinated upon the completion and the handle wired to prevent operation.

The crew consisted of one well foreman and two laborers. They set the truck in proper position to drive the well. The rear end of the truck served as a work platform during the driving operation. The first operation consisted of digging, with a post hole auger, a hole sufficiently large to receive the 4-inch steel well housing.

PLATE 277

This well housing was 4 feet long with a fixed elevation of the top approximately 18 inches above grade, with the lower end approximately 30 inches below grade. The second operation was to bore manually, using a 2-inch soil auger with extended handle, to receive the first 10-foot length of pipe. The purpose of this boring operation was to penetrate the strata of hardpan which was generally encountered at an elevation ranging from three to ten feet below the surface of the ground.

The next operation consisted of screwing sand point on to the first 10-foot length of pipe and inserting same in the 2-inch bored hole. The second joint of pipe was then screwed to the top of the first joint and driven in position using the driving cap.

PLATE 278

Water was encountered at varying depths but seldom above the 20-foot below surface elevations. The method of testing to find out if an adequate supply of water existed was to lower a sounding weight on the end of a cord. The drive pipe was extended in depth, as needed, by the addition of 10-foot lengths of pipe driven until an adequate supply of water was encountered.

PLATE 279

The water-bearing stratum of gravel was found to be 3 feet or less and did not have a common horizon. This fact made it necessary to locate the sand screen within the vertical limits of this water-bearing stratum. To accomplish this, frequent soundings were necessary, to determine when the sand screen was in proper position.

The drive pipe was cut off at the fixed elevation of the pump cylinder and the top end threaded to receive the assembled pumping unit.

PLATE 280

The design of the pump assembly necessitated an ingenious method of installing the pumping cylinder. The top end of the drive pipe was at a necessarily fixed elevation and was determined by the fixed elevation of the finished pump platform.

It is obvious that the accurate location of the drive pipe top would not occur simultaneously with the proper position of the sand points. When the sand point was properly seated, the top length of drive pipe was marked at the proper location for the bottom of the cylinder and the last 10-foot length was unscrewed. A thread was run on the end of the withdrawn pipe when cut. This end was placed downward in the hole and after landing in the lower pipe coupling was screwed home by means of a tool consisting of a 4-foot length of drive pipe with a fixed "T" handle on the top end, and a standard coupling screwed tightly in position and set with center punch marks at the other end. When the top end of the drive pipe, previously cut to length, was screwed tightly into position, the wrench was removed by a sharp rap on the handles which caused it to unscrew from the top end of the drive pipe.

PLATE ~~281~~ 280 A

The pump assembly was installed by lowering the cylinder end through the housing and screwing into place on the top end of the drive pipe. This joint was liberally coated with graphite to insure easy uncoupling for necessary maintenance repairs.

The sanitary base, an integral part of the pumping assembly, was fitted into position over the top end of the 4-inch steel housing and the set screws tightened to complete the installation. The concrete collar, as indicated on the drawing, was then put in place around the steel housing and the 6-inch blanket of sand placed above the concrete collar prior to filling the excavation to an elevation suitable to receive the concrete platform at a later date.

The chlorinating solution was prepared and placed in the well to effect sterilization. The pump handle was wired to prevent its operation before the necessary lapse of time to make the chlorination effective. The effectiveness of this chlorination was checked, usually one week or less, after the completion of the well by the field representative of the State Director of Public Health. In some cases the bacteriological test of this water was positive and such wells were immediately re-chlorinated. The reason for the positive results were partly due to carelessness in collecting samples and in some cases due to the very ordinary necessity of chlorinating newly constructed wells, in some cases three or feur times, to accomplish complete sterilization.

DRIVES

The location and trace of all drives and culverts was established by the Land Planning Engineers and the Civil Engineer. The Civil Engineering Section not only staked out this work, provided the essential grades, etc., but, also provided a material amount of supervision and inspection service for the actual construction operations.

As indicated in the preliminary discussion, the necessary bulldozers, tractors and grading equipment could not be secured within the time limit allowed for this construction activity. Some of these drives, and specially the culvert and entrance drives, had to be constructed in rough form before the construction transportation crew could enter the site for delivery of materials and equipment. Careful planning and coordination in scheduling was necessary in this operation. It necessitated the personal attention of the Construction Engineer. The essential equipment needed for these operations was borrowed from the County Road Commission. Without this courtesy and assistance this particular item might have seriously hampered this work or even prohibited the construction of this project within the time limit.

Corrugated metal culverts were set at the point where each drive entered the road. These culverts were placed in accordance with the design of our own Civil Engineering crew on Project roads and in cooperation with County Engineers on County Roads. The drives were shaped, drainage cut, and the rough graded road was used during the construction period, filling in the soft spots, ruts, etc. In some cases it was necessary to actually gravel a road during this period. In all cases, after construction was completed, the drive was completely gravelled with a 4-inch layer. It was expected that this 4-inch layer would work into the road surfacing and that eight to ten months later an additional layer of gravel would have to be spread. This is standard practice of all "farm-to-market" roads in this particular area.

No headwalls were used in the culvert construction, except in isolated cases where specific and special problems were encountered. Most of these difficult cases were handled by the Civil Engineering crew and constructed under their direct supervision. One of the most interesting culvert

cases in this construction occurred at the junction of the main drainage ditch and two intersecting road ditches, at a point where the railroad right-of-way intersected the main highway. This was the only serious road construction problem, other than drainage and grading, on the project.

In addition to the construction of entrance drives and farmstead drives, it was necessary to actually construct some "farm-to-market" roads on this project. The location of these roads was determined by the Land Planning Engineers and the design, location and layout of the roads was handled by the Civil Engineer on-site. The construction engineer utilized the services of the Civil Engineer on-site, as a supervising superintendent. He was provided with the necessary machine operations, (such machine equipment was generally supplied by loan from the County Road Authority), and the necessary materials and supplies for these operations. The roads constructed were of a type exactly similar to the standard "farm-to-market" roads used in this community by the County Road Commission, and fitted in with the existing system.

Great care was paid to proper drainage of these roads and tying this drainage into the general drainage system of the area. These road beds when graded were also utilized in their raw state for construction purposes. At times this caused hardship for construction transport activities, but it would establish a stable road bed. After construction was completed, the County Authorities gravelled these roads (excepting a few isolated sections that could not fit into the county system), in the same manner previously described for drives and in keeping with the standard "farm-to-market" road program within the county.

PLATE 299

REPAIR AND REMODELING ACTIVITIES

The repair and remodeling activities, as they effected the construction of this project, proved to involve more difficulties and more trouble than the new construction work. A great deal of inspection and discussion was necessary in the early stages of these operations to determine what buildings, if any, were possible of economical repair and remodeling operations.

PLATE 300

A building, to be repaired, should have at least its structural members sound, or the majority of them, and the repair and remodeling operations should be concerned with improving its structural soundness and replacing such things as roof, siding, flooring, etc., that have been worn out. The majority of the buildings on this project, having no real structural strength, were not possible of repair operations, when the roof and sidewalls gave way. The structural strength of most of the buildings consisted of the boards used for the sidewalls.

Seven houses were finally selected for repair and remodeling operations. One of these houses was the old plantation home and was selected for the use of the farm manager. This house was completely reconditioned and modernized by the addition of a bathroom, electric generator, septic tank, disposal field, and an automatic water system. The District Engineer was very glad for the opportunity to make this experimental operation to determine the feasibility of this type of modernization in this area.

PLATE 301

Even this house, which was in first-class condition, had to be completely reconditioned with new floors, wallpaper, new roof, additional porch, new windows, etc.

Eight barns were retained to be repaired and remodeled. This included one large barn, located on the same plot as the farm manager's house, to be used for a cooperative storage and management purpose.

Generally speaking, all the repair operations clearly

substantiated the decision, that it would be more costly to repair structures than to build new ones replacing them. Those units selected for repair were, in most cases, larger houses than those designed for the project. They were in sufficiently good condition to justify their repair and remodeling, for use by clients with extremely large families.

PLATE 302

It is interesting to note that practically every house and barn selected for repair was constructed on structurally sound principles. These buildings, so constructed, had withstood use demands and were still usable; while those of flimsy box construction, utilized extensively in this area, had in most cases completely disintegrated under similar periods of time.

It was decided to utilize these repair operations, so far as possible, as a catch-all for miscellaneous materials and labor which had completed definite assignments in the construction program. For this reason most of these operations were started during the last period of the construction cycle. They were performed by labor groups, after they had completed their particular part of the new construction activities. This automatically enabled the utilization of any material surpluses or material "rag-tags" that it is possible to salvage. There was no particular system employed in carrying out this work. Timing and scheduling was entirely dependent on the availability of labor and material for the purpose.

One specific instance, worthy of mention was a store building included in the buildings purchased within the area. A store building was necessary for the cooperative operation of this project. The existing store building was carefully checked by construction personnel. It was their considered conclusion that in order to make it available to perform its function as a cooperative store, the building would have to be completely demolished, a new foundation and floor joists system installed, and, because of the absence of windows, doors, etc., it would be cheaper to completely dismantle the sidewall structure and rebuild the same. The metal roof was in bad condition to start with and would not stand taking apart and reassembling. A careful estimate was prepared, concerning the cost of such an operation. The cost of direct repair was only a fraction of the total cost involved, because "use demands" called for extensive remodeling.

The District Engineer and the construction engineer reduced the management requirements to square foot floor demand. During a luncheon conference with the management personnel, the District Engineer compared these floor demands to the usable floor space that would be given by three standard houses and found it to be approximately equal. By joining two of these houses end to end and using the third as a "T" addition, a very desirable store arrangement, consisting of the store proper and a separate storage and warehouse room was possible. On the back of an envelope this was rapidly sketched and dimensioned and approved by all present. Utilizing the prefabricated sections and adjusting same to use some transferred material, unusable in standard houses, such as wide garage doors, casement windows and variable types of framing lumber, the entire structure was completed in ten days, ready for use at a cost less than the estimated repair and remodeling cost of the old building. The total cost of this combined building was considerably less than three separate farm houses. The framing material referred to was utilized to make a specially designed floor and joist system to take care of store loads. After a year's use, this structure has proven extremely satisfactory.

A major repair and remodeling problem was presented in the conditioning of the cotton gin and its associated buildings. The building itself was in fair condition and needed only repairs to replace wear. The equipment was part new and part old. Some of the old equipment had been reconditioned and overhauled so many times that any further activity of this type was a waste of money.

Having little experience with this kind of machinery, the facilities of the Department of Agriculture were utilized to secure expert advice. Conforming strictly to their recommendations, careful specifications were drawn for the purchase of new equipment where indicated and it was installed in exact accordance with the design and advice given by the Department specialists. A time element was involved which presented major difficulties. However, due to the cooperation of the Procurement Section of the Treasury Department, located at Jefferson City, the handling of this unfamiliar activity, under difficulty was completed shortly after the June 30th limit imposed, and in plenty of time to enable the equipment to be used for the 1938 crop.

The material salvaged from the demolition of the old store building and from the demolition of some of the other larger buildings on the project, supplemented by salvaged materials from the construction operations, were utilized to provide a blacksmith shop and cooperative storage building, hammer

mill and enclosed garage. The design of this building is rather interesting. Two standard barns were located end to end with a 24-foot area between. This area way was roofed over and later completely sided in. This made a shed building approximately three barn-lengths (84 feet in length and 32 feet in width), which has been one of the most useful structures on the project. It has served as a community building, theatre, a supplemental field office, etc., as well as performing the functions for which it was originally erected. Certain changes in the post and purlin arrangements of the barn design were necessary in this adaptation.

The general description of the yard and field operations that have been given are outlined in diagrammatic form by Plate #299 . Careful and detailed progress schedules were developed for all of this work. Plate #304 is a sample of this progress schedule, showing the actual operations of units 1 to 15.

The Labor Relations Division, from the records submitted to them have compiled a table of general report statistics which present a very interesting summation of the labor employed on this project.

There has been some criticism of the utilization of this type of engineering organization, in that it does not conform to the standard conceptions of Building Trades Unions. It is the belief of the District Engineer that this project definitely demonstrates the fact, that properly handled, this is not the case. The labor chart shows that during the initial stages, a majority of relief labor or non-relief labor, assigned through the U.S.E.S., was utilized; during the last two months, when the farming and building operations of the territory picked up, a very definite shortage of labor of all types occurred, which was at a period when the maximum amount of construction activity was necessary to meet our assigned time schedule. This is the only period where labor imported from the outside was used.

PLATE 303

It will be noted the steady increase in the utilization of labor in the higher skill brackets. As a matter of fact this did not actually occur, but, due to the organization used, it was possible to classify unskilled labor, at a skilled labor rate, because they were producing quality and quantity of work comparable to that which would have been produced by the skilled trade. Wherever and whenever

labor of the skilled class was available, it was naturally preferred in any case, where the construction engineers themselves had anything to say about the matter.

It is perfectly obvious that any contractor or any builder not restricted by Governmental regulations, utilizing a system similar to this, would in no way, violate any of the conceptions of the building trades unions and would greatly benefit to have skilled carpenters performing any of these functions rather than paying the same rate for apprentice or unskilled labor.

In other words, taking an unskilled man because skilled mechanics were not available; during actual progress of the work we made this unskilled man into a skilled laborer for a particular and specific portion of his trade and were entitled to pay him a skilled rate for that particular operation. If we had been able to employ skilled labor, we would have paid them the same rate, but we could have moved them into any particular operation on the job and that would have been an extremely valuable facility for the construction engineer.

Another criticism that has often come to the attention of the District Engineer wasthis system of construction, caused an apparent regimentation of carpenter mechanics. It was obvious that there was absolutely no speedup in the yard operations; after the mechanics became acquainted with the work they were performing a large volume of good quality work was produced in a leisurel and professional manner, that is seldom seen on any job, excepting where the highest skilled technicians are employed.

During the initial stages of this operation, when large numbers of skilled carpenters were requested, out of 25 men reporting for duty, 20 were discharged as being completely incompetent to perform first-class carpenter work. Within a week all of these men were reclassified as unskilled or semi-skilled laborers and returned to the job. Before operations were completed practically all of these men had been reclassified so far as pay was concerned, to the classification of skilled mechanics and they <u>were</u> skilled mechanics in a <u>particular phase</u> of the operation and therefore entitled to this pay classification.

ADMINISTRATION

Personnel, who were qualified by experience and training for Administration Construction Work, were transferred from other projects as a nucleus of the administrative staff.

The Personnel Division, Washington, D. C., furnished a list of local applicants from which all clerical positions were filled. After obtaining this list, a letter was sent to each of the parties listed, requesting them to come to the project office to be interviewed and to ascertain which of the clerical positions they were qualified to fill. After the interview, if accepted, they were required to fill out Form RA-PE-3, "Personal Data Memorandum", in triplicate. Form RA-PE-87, "Temporary Field Work Agreement," was made out in original and four copies, and presented to the prospective employee for his or her signature. The address and telephone number was then taken and the prospective employee was told that he or she would be notified when to report for work.

After Form RA-PE-87 was signed by the Construction Engineer, the original and three copies, with the three copies of Form RA-PE-3, were transmitted to the Personnel Division, Washington, D. C., with a letter requesting the appointment of each prospective employee.

After a lapse of approximately thirty days, the appointment was made. The Construction Engineer received two approved copies of Form RA-PE-87, one copy was filed in the administrative files and the other was sent to the Regional Finance and Control Division, Indianapolis, Indiana, as authority to pay all payrolls submitted for this employee. The person was notified to report for work on the "entrance on duty date", specified on the Temporary Field Work Agreement. Temporary Field Work Agreements could cover a period of not to exceed ninety days. This period acted as a probation period and if employee was satisfactory, and his services needed beyond the ninety day period, a request for an Emergency Appointment was made approximately thirty days before the termination of the Temporary Field Work Agreement. Form RA-PE-100, "Termination of Temporary Field Work Agreement," in original and three copies, and Form RA-PE-6, "Personnel Recommendation," in original and three copies, for each employee involved, was submitted to the Personnel Division, Washington, D. C. After approval by the Personnel

Division, two copies of RA-PE-100 and one copy of Form RA-PE-31, "Notice of Appointment," were sent to the Construction Engineer. Form RA-PE-100 was filed, the other sent to the Regional Finance and Control Division and the one copy of Notice of Appointment was given to the appointee.

Due to this lengthy procedure in securing appointment of personnel, this activity was one of the first steps taken in the starting of any operation.

Non-appointive personnel, used as a part of the administrative staff, were hired in accordance with Administrative Instruction Number 41, Revisions 1 and 2, as labor.

Plate 299 outlines the duties of the administrative personnel.

The Clerk of the Works was in direct charge of the Administrative Staff and its functions. His duty was to co-ordinate all work. His decision on questions concerning the interpretation of regulations was final unless overruled by the Construction Engineer.

The Assistant Clerk of the Works had direct charge of the cost section. It was his duty to collect, record, and report data needed for keeping cost records in accordance with the procedure set up by the District Engineer's Cost Section. He was in charge in the absence of the Clerk of the Works.

The Chief Material Clerk was in charge of the warehouse. It was his duty to check and inspect, both as to quantity and quality, all incoming materials and to see that all materials were charged out when they were delivered to the field or Job Plant, in accordance with established procedure. Four Checkers were assigned to assist.

The Head Timekeeper was assigned to the duties of maintaining all time records. Five timekeepers were assigned as assistants. Two kept time on all workers in the field and were full time employees. Three kept time on all workers in the Job Plant and also served as material checkers. The Head Timekeeper prepared and submitted all reports pertaining to injuries incurred on the job.

A Clerk Stenographer was assigned to the Resident Engineer as Secretary to answer incoming correspondence, type all requisitions for purchase, and maintain the procurement register. Two cost Clerks maintained inventory records of materials, supplies and equipment cost in accordance with

established procedure. Two Stenographers typed and filed semi-monthly time reports, cost reports, receiving and inspection reports, and miscellaneous correspondence. Four Watchmen were necessary to police the warehouse site and guard against thievery and fire.

The only Contract service required at the start of Construction was telephone service. Requests for this type of service were made to the Regional Contract Officer in Indianapolis, Indiana, in the form of a letter. Approximately ten days were required for the execution of the contract and service could not be obtained prior to its execution. The only type of service available was on a party line, and it was approximately four weeks before a private line was installed.

After construction started it was necessary to obtain additional land and warehouse space. Request for a lease of warehouse and land was made to the Contract Officer. Before a lease could be drawn it was necessary for a representative of the Contract Office to visit the site and obtain all information for the lease. It was approximately thirty days before the executed lease was received and use could be made of the land and warehouse.

Before any service under contract of lease could be discontinued it was necessary to notify the Regional Contract Officer in sufficient time so that he could give the Contractor or Leasee thirty days notice before the discontinuation date.

Payment of contractual services were made by the preparation of Standard Form 1034, "Public Voucher for Purchases and Services Other than Personal." This form was prepared in original and five copies. The original and four copies were sent to the Finance and Control Office, Indianapolis, Indiana, with the original and two copies of the vendors invoice. There it was placed in line for payment.

Before these vouchers could be paid it was necessary for the Construction Engineer to prepare Form A-5, "Notice of Miscellaneous Encumbrance." This form was prepared each month to cover rental of warehouse and ground space, telephone service, telegraphic service, office supplies and equipment. Form A-5 was prepared in quadruplicate with the original and two copies for the Finance and Control Office and one copy for files. After the Finance and Control Office set up this encumbrance, vouchers submitted were paid from this encumbrance.

Materials, construction supplies and equipment used in the construction were obtained from two sources; transfers of surplus materials from other projects and by procurement through the State Procurement Office at Jefferson City, Missouri.

A request was made by letter, to the project involved, to make immediate shipment of surplus materials, supplies and equipment as listed in the request. The shipping project prepared Form RA-Gen 77, "Transfer of Materials, Supplies and Equipment," in quintuple. On this form was listed all items which were being transferred, showing the original cost, usage rate and salvage value of each item. The shipping project retained the last copy and forwarded the remaining copies to the Construction Engineer. Upon receipt of the materials, a careful check was made to see that all items listed were received, and if correct, all copies were signed by the Construction Engineer and the receiving date placed in the space so provided. The first or green copy, was retained for record and file, the original was returned to the shipping project and the other two copies were forwarded to the District Engineer's Cost Section.

Many of the items of surplus material were of a grade and quality not generally used in construction of farm buildings in that part of the country, so in all fairness to this operation a valuation was placed on this material in accordance with local market prices. Lumber dealers in that vicinity were contacted and a local price list was obtained and used as a basis for revaluation of surplus materials transferred.

Surplus materials, supplies and equipment were shipped by railroad on a Government Bill of Lading. This form was prepared and encumbered by the shipping project, and the original and one copy sent to the Construction Engineer who, upon receipt of the shipment, placed the name of the carrier, the weight of the items in the shipment, the date received, and his signature in the space provided. The original copy was given the carrier's agent and a copy retained for files.

Reimbursement for this surplus materials, supplies and equipment was made to the shipping project by using Standard Form 1080, "Voucher for Adjustment Between Appropriation or Funds." This form was prepared by the shipping project and showed the project name, number of project, funds to be credited, name, number of project and funds to be debited. In the body of this form was listed all materials, supplies and equipment and the price for which reimbursement was claimed. In addition, the Disbursing Officer's citations was shown covering the original purchase

of the materials, supplies and equipment listed on this voucher. This voucher was initialed by the Construction Engineer of the shipping project and sent to the receiving project. The Construction Engineer of the receiving project, when he approved, initialed it, retained one copy, and forwarded the remaining copies to the District Engineer's Cost Section, Washington, D. C., where it was placed in line for payment.

The first step in the procuring of new materials, was to prepare Form A-6, "Requisition for Purchase." This form was prepared in the original and five copies. Each requisition was numbered numerically, starting with number one. Two types of requisitions were used; namely, Regular and Blanket. Regular requisitions were used where large quantities of materials, supplies or equipment were requisitioned. Blanket Requisitions were used for purchases of less than three hundred dollars ($300.00) on one requisition.

In preparing regular requisitions it was necessary to fill them out in detail in accordance with Treasury Department Regulations. The block in the upper right hand corner showing the requisition number, appropriation symbol, official project number, location symbol, type of work symbol and the amount of the encumbrance was filled in. Above this block and on the left side is posted the date of issue, the name and title of the authorized administrative official, and the name and location of the Government agency. Below this block is the address of the Procurement Officer and the appropriation symbol, title, name, title and address of the consignee. In the body of the requisition is shown the quantity, description and specifications of the materials, supplies or equipment. Great care was taken in preparing the description of the items and specifications so as to clearly show the type of materials, supplies and equipment which was required. If many items were shown on one requisition it was necessary to use a continuation sheet, prepared in the same number of copies as the requisition. On the reverse side of the requisition was shown the name and number of the project and a description of the type of work being done. The requisition was then ready for the signature of the Resident Engineer and to be transmitted to the Finance and Control Division, Indianapolis, Indiana, in the original and four copies.

After the requisition was encumbered, the original was sent to the State Procurement Office at Jefferson City, Missouri and one copy was returned to the project.

Approximately ten days were required before the requisition was encumbered and received by the State Procurement Office.

Upon receipt of the encumbered requisition, the State Procurement Office prepared invitations to bid which were sent to dealers of the type of materials requisitioned. These bids were returned to the State Procurement Office prior to the opening date which was set at least ten days from the date of issue of the invitations to bid.

After the contract was awarded, the Procurement Office issued Form A-7, "Purchase Order," one copy of which was sent to the project. The actual delivery of materials required five to fifteen days. The total lapse of time from the date of issue to the time the materials were received was at least thirty days.

Upon delivery of the materials, supplies or equipment at the project, they were checked as to quantity and specifications, and upon acceptance, Form A-8, "Receiving and Inspection Report," was prepared in original and two copies.

The name of the vendor, the name of the project, the purchasr order number, and the receiving date were shown at the top of the form. In the body were listed all items received showing the quantity, description and specifications. The acceptance or rejection of these items was signified at the bottom of the form in the space so designated. This report was then signed by the Resident Engineer. The original and one copy were transmitted to the State Procurement Office.

Blanket Requisitions were prepared in the same form as outlined for Regular Requisitions and the distribution of copies was the same. These Blanket Requisitions were set up for the procurement of materials, supplies, and equipment on subsidiary requisitions and covered a one-month period. Each month the project would set up a Blanket Requisition for one thousand dollars ($1000.00). This requisition was prepared on the twentieth day of the preceding month for which the Blanket Requisition was to be used. This was done so that the encumbered Blanket Requisition would reach the State Procurement Office on the first day of the month. The project, upon receipt of its encumbered copy, would issue subsidiary requisition against the Blanket Requisition. The subsidiary requisitions were prepared in the original and one copy and the original copy was sent direct to the State Procurement Office, where it was handled as outlined under Regular Requisitions. Each

subsidiary requisition had to be for an amount of less than three hundred dollars ($300.00). The use of subsidiary requisitions expedited the procurement of materials, supplies, and equipment by at least ten days, as they did not have to go through the Treasury Office for encumbrance.

Form A-5a "Change in Encumbrance" was another form used by the project in connection with procurements. This form was used for increase, reduction, or cancellation of encumbrances. The original and five copies were prepared. The original and four copies were sent to the Treasury Accounts Office, Indianapolis, Indiana, and the fifth copy was retained for the project files. After this form had been approved by the Treasury Accounts Office, an approved copy was returned to the project office. Approximately thirty days were required for the liquidations and ten days for increases or reductions.

Office supplies and equipment for project use were obtained by the use of Form RA-Bm 9, Request for Supplies, Equipment, or Services. This form was prepared in the original and three copies. The original and two copies were forwarded to the Regional Supply Depot, Indianapolis, Indiana, and the third copy retained for project files. Each request covered approximately thirty days requirements and was prepared thirty days in advance. This was necessary to eliminate numerous requisitions and to allow the supply depot enough time to fill the requisition and ship the supplies to the project. Small parcels of supplies were sent by mail and large parcels by Government bill of lading. Accompanying each shipment was a copy of the request which was used in checking the shipment, after which it was signed by the Resident Engineer. This copy was then returned to the Supply Depot and served as the project's acknowledgment that the supplies listed had been received.

All Compensation and Safety was handled in accordance with rules and regulations furnished by the Labor Relations division, Washington, D. C., in cooperation with the Federal and State Compensation Commission.

Under these regulations there were two types of procedure to follow in preparing Injury Reports. All persons employed and paid, at the time of injury, from Corporation Funds and those paid from Emergency Relief Funds. Reports for injuries sustained by employees paid from Emergency Relief Funds were made to the State Compensation Commission, Jefferson City, Missouri. Reports for Injuries sustained

by employees paid from Corporation Funds were made to Mr. L. L. Lockman, Compensation Officer, Labor Relations Division, Washington, D. C. With the exception of the last payroll period in June, all employees were paid from Corporation Funds.

A separate file was maintained on the project for copies of all reports and correspondence pertaining to each injury case. Each file carried the name of the injured and the number shown on the Project Claim Register, and was filed in alphabetical order until such time as the case was closed, after which it was re-filed in numerical order. Form RA-LR 16, Project Claim Register, was maintained on the project by the Project Injury Officer. Each injury was recorded on this register and given the number in which it appeared on the register. The progress of each injury was recorded by placing the date of issue of each report submitted.

Form RA-LR-8, Foreman's Accident Report, was prepared by the foreman for each injury. This form was prepared in triplicate. The original was sent to the Compensation Officer, Washington, D. C. The second copy was sent to the Regional Labor Relations Representative, Indianapolis, Indiana, and the third copy was retained for project file. If the injured person was in need of medical attention, an Authorization for Medical Treatment was prepared and the injured party sent or taken to the doctor. This form was prepared in triplicate. The original was sent to the doctor with the injured party and the second copy was submitted to the Compensation Officer. The third copy was retained in the project files. If the injury was a minor one, the injured person was given first aid on the project.

Form CA-1, Employee's Notice of Injury and Original Claim for Compensation and Medical Treatment, was filled out by the injured party and his signature placed on the designated line, at the bottom of this form. This form shows the type of injury received, the cause of injury and the names of witnesses if they were available. This form was prepared in triplicate, the original and one copy sent to the Compensation Officer, and the third copy retained for project files.

Form CA-2, Official Superior's Report of Injury, was used for all injuries in need of medical treatment. On this form was shown the place of employment, name of injured, age of injured, type of injury received, cause of injury, witnesses to injury, name of the doctor to whom injured was sent and the signature of the Official Superior. On

the reverse side of the form was the statements of the witnesses, their signatures, and a report of the doctor. On the margin of this form was shown the appropriation number, the W.P. number, and whether or not the injured was Non-Appointive Relief or Non-Relief. This information was especially necessary during the periods the project was using two types of funds, in order to show the fund from which compensation benefits were to be paid. This form was prepared and distributed the same as Form CA-1.

Form CA-4, Claim for Compensation on Account of Injury, was executed where the injury involved loss of time and was signed and notarized by the claimant. The reverse side of this form was filled out by the doctor and signed by him. The form was then distributed as outlined for Form CA-1.

Form CA-32, Report of Hernia, was executed when a hernia was the type of injury received. This form was filled out in detail by the injured and the attending doctor and distributed as outlined for Form CA-1.

Form LR-9, Project Injury Officer's Monthly Report, was prepared and submitted prior to the fifth of the succeeding month of the month covered by the report. This report showed the number of injuries involving first aid, lost time and medical treatment. It was prepared from information obtained from the Project Claim Register. It was prepared in duplicate with the original going to the Compensation Officer and the copy for the project files. Payment of medical expense, for injuries to employees paid from Corporation Funds, was made by the use of Standard Form 1034, Public Voucher for Purchases and Services other than Personal. This form was prepared in the original and five copies and submitted to the Finance and Control Office in the original and four copies. Attached to this form was the doctor's invoice in triplicate. One copy of the voucher and invoice was retained in the project file. Authorization for payment of this voucher was made to the Finance & Control Office by the Compensation Officer after he had approved the doctor's invoice.

Payment of compensation was made by the use of payroll for Compensation. This form was prepared by the Payroll Unit after they have received the proper authorization from the Compensation Officer, and sent to the project for certification as to the hours for which compensation is claimed. One copy of this payroll accompanied the check to the

project and was placed in file.

Injury reports for persons paid from Emergency Relief Funds was prepared the same as those outlined for persons paid from Corporation Funds, with the following exceptions. Form CA-16 was used as the authorization for medical treatment and Form S-69 was used for payment of medical expense. All reports with the exception of Forms LR-8 and LR-9, were made to the State Compensation Commission instead of the Compensation Officer, Washington, D. C.

Form A-5a "Change in Encumbrance" was another form used by the project in connection with procurements. This form was used for increase, reduction, or cancellation of encumbrances. The original and five copies were prepared. The original and four copies were sent to the Treasury Accounts Office, Indianapolis, Indiana, and the fifth copy was retained for the project files. After this form had been approved by the Treasury Accounts Office, an approved copy was returned to the project office. Approximately thirty days were required for the liquidations and ten days for increases or reductions. Office supplies and equipment for project use were obtained by the use of Form RA-BM 9, Request for Supplies, Equipment, or Services. This form was prepared in the original and three copies. The original and two copies were forwarded to the Regional Supply Depot, Indianapolis, Indiana, and the third copy retained for project files. Each request covered approximately thirty days requirements and was prepared thirty days in advance. This was necessary to eliminate numerous requisitions and to allow the supply depot enough time to fill the requisition and ship the supplies to the project. Small parcels of supplies were sent by mail and large parcels by Government bill of lading. Accompanying each shipment was a copy of the request which was used in checking the shipment, after which it was signed by the Resident Engineer. This copy was then returned to the Supply Depot and served as the project's acknowledgment that the supplies listed had been received.

All labor with the exception of Appointive Personnel was requisitioned from the United States Employment Service. This labor included skilled, unskilled, and some non-appointive supervisory personnel. Labor was requisitioned on W.P.A. Form 401 - Requisition for Workers. This form was prepared in triplicate, signed by the Resident Engineer and the original and one copy was sent to the local U.S.E.S. office. Personnel requisitioned were assigned

to the Project by the use of Form U.S.E.S. 320. One copy was given to the worker, who presented it to the head timekeeper upon reporting for work. The head timekeeper then prepared a Corporation Employment Agreement card in duplicate and had the worker sign both copies. The worker was then given a numbered badge. This number was used as an identification during working hours. The head timekeeper inserted the date upon which the employee reported for work on the Form U.S.E.S. 320, signed on the space provided and returned the accomplished form to the U.S.E.S. office. This served as notification to the U.S.E.S. office that the party assigned to duty had reported for work and was employed.

The head timekeeper sent the original copy of the Corporation Employment Agreement card to the Regional Finance and Control Division, Indianapolis, Indiana, as their authority to pay this employee. Whenever an employee was re-classified from one job to another, the Finance and Control Division in Indianapolis was sent a copy of the re-classification. If this was not done the payroll for the man involved would not be paid, due to the fact that he was classified under another job by the payroll unit. It was imperative that all re-classification slips be sent to the payroll unit prior to the end of the payroll period. It was also necessary to send both the Finance and Control Division and the U.S.E.S. office notification of termination of employees. The payroll unit needed the termination notification in order to place the man on the available list.

Form RA-CN-50, Daily Time Distribution Ticket was used to report the daily time of the assigned labor. These forms were turned in daily by the field and yard time keepers. The day and date, weather conditions, name of project, unit number, kind of employment, construction item, account number. The badge number and employee's name, rate of pay, total hours worked and total amount due is all reported. Approximately thirty (30) men can be turned in on one ticket.

There are also several columns showing the hourly distribution and cost of time worked against individual production orders. For example: John Doe worked eight (8) hours for the amount of $4.00. On one line of this Daily Time Ticket is his name and rate of pay, his total hours, and his total amount. On this same line his breakdown as per production order is shown. Two hours for one dollar to production order 1020, four hours for two dollars to production order 1023, one hour for one dollar to production

order 1026, and the quantity of work completed during the day. This daily time ticket, signed by the foreman and the timekeeper, was used not only for posting the daily time to the Master Time Sheet but also in posting daily labor costs to the production order cost sheets.

A large board was erected and on it were hung identification disks to correspond with the badge numbers of each worker. Every morning the worker was required to report to the window prior to going on duty. He was given this identification disk and each evening when he returned from duty he was required to turn this disk in. During the morning the numbers for all the vacant spots on the board were listed, with the men's names opposite each number. This gave a record of all workers on duty during the day, and the daily time sheets were checked to see if any names had been omitted. This system not only kept the field and yard timekeepers from omitting the names of any workers on duty, but it also prevented any men being shown on the daily time sheets who were not actually working.

Form RA-GEN-45 - Semimonthly Time Report was used as the Master Time Sheet. The page number, official project number, work project number, appropriation number, region number, Division, Project, location, and payroll period headed this report. The payroll was broken down into three sections, non-appointive supervisory, skilled and intermediate labor, and common labor and relief and non-relief were also kept separate. Within each division the employees were listed in order according to rate of pay, and in the case of instances where more than one was classified in the same category, such as First Class Carpenters, their names were listed in alphabetical order. The body was broken down into fourteen (14) columns. Column one contained the line number; column two contained the list of employees. Column three was for the sex of the worker; column four contained the U.S.E.S. identification number; column five contained the occupation of the worker; column six was for the class: skilled, non-appointive supervisory, unskilled, etc.; column seven contained the dates and hours of labor according to date, of each worker; column eight contained the total hours worked for the period per individual worker; column nine contained the rate of pay; column ten contained the unit of work, hourly and monthly basis; column eleven contained the gross amount earned per individual worker, also the total per page; column twelve contained deductions, column thirteen contained net amount due; and column fourteen was the remarks column. This column was for entered on duty date, re-

classification date, or termination of worker. This Master Time Sheet was posted daily by the head timekeeper or one of his assistants, from the Daily Time Distribution Tickets. At the end of the payroll period the Master Time Sheet was totaled, checked for accuracy, and typewritten in triplicate. After being approved and certified by the Resident Engineer and timekeeper, the original and one copy were sent to the Regional Finance and Control Division, Indianapolis, Indiana and one copy was retained for the project files. It was necessary that the total amount of the payroll equal the total amount of the Daily Time Sheets for the fifteen days. Since one small error in posting would throw the whole payroll out of balance, a daily control sheet was drawn up for the project. On this the payroll was balanced daily with the Daily Time Distribution Sheets. The control sheet contained columns for hours worked, rate of pay, and amount due. After the posting had been made for the day, the Master Time Sheet was checked and posted to the daily control sheets. Then the Daily Time Sheets were checked and also posted to the daily control sheet. If the two coincided the posting for the day was in balance. The Control Sheet was then attached to the Daily Time Sheets and turned over to the District Engineer Cost Analysis Section for posting to Production Order Cost Sheets.

After the payroll was sent to the Finance and Control Division, Forms RA-GEN-77 and 77A, Employment Reports for Administrative Payroll and Labor Payroll were prepared and sent to the District Engineer's Cost Analysis Section, Washington, D. C. This report listed the various classifications under administrative, supervisory, technical, clerical, skilled, semi-skilled, and unskilled labor, by appointment and assignment, relief and non-relief. It also listed the total man hours for the period per each classification of labor. It was necessary that this report balance with the payroll.

For appointive employees; Form RA-GEN-35, Semi-monthly Service Certificate, was sent in to the Finance and Control Division and served as a semi-monthly payroll. This form contained lines for the Division, the State, the project name and number, the period, and the region number. The body consisted of six columns which were as follows: Column one was for the names of the employees, which were arranged alphabetically, last name first. Column two was for the designation of the employee; column three was for the Executive Order Grade of the employee, who was graded as per Government regulations; column four was for the

salary rate of the employee; column five was for Leave Without Pay, column six was for remarks, such as "entered on duty date", date employee went on leave, date returned to duty, etc. This payroll was submitted to the Finance and Control Division several days before the payroll period ended. On the last day of the payroll period the Resident Engineer certified this payroll by wire. After the wire was received by the Finance and Control Division, the payroll was prepared for payment.

The head timekeeper submitted a weekly labor report by telegram to the District Engineer's Cost Section not later than Saturday of each week. This telegram contained the number of appointive, non-relief, relief, and homesteaders who had worked on the project payroll during the preceding week and was used by the Department of Labor in preparing labor statistics.

PLATE 305

The basis for the property control of the project was the Perpetual Inventory system. This inventory was divided as follows: material inventory, construction supplies inventory, motorized and mechanized equipment inventory, office equipment and supplies and non-expendable property inventory, inventory for materials and supplies and equipment held in storage for other projects and divisions.

All transactions involving any inventory items except motorized and mechanized equipment, was recorded on Form RA-GEN-65, Perpetual Inventory Card. Form RA-GEN-93 was used for recording receipts and depreciation of motorized and mechanized equipment.

Form RA-GEN-65 was headed by an item line on which the full description of the article was recorded. Under this line was the place for unit of measure and unit cost. The body of the card was broken down into five main columns to record receipts, issues, balances, inventory check, and remarks. Columns one to five inclusive were under receipts; columns six to nine inclusive were under issues; columns ten and eleven under balances; twelve to thirteen under inventory check; and fourteen under remarks. The date an article was received was placed in column one. This date was taken from Form A-8, Receiving and Inspection Report. Column two contained the date of the purchase order; column three contained the purchase order number. Column four contained the quantity of the item received. Column five contained the cost of the item received. Column six contained the date of issue of material to construction.

This date was taken from the Material Delivery Ticket, Form RA-GEN-61. Column seven contained Material Delivery Ticket number. Column eight contained quantity of material issued. Column nine contained cost of material issued. Column ten contained quantity of balance on hand. Column eleven contained cost balance on hand. Column twelve contained book inventory. Column thirteen contained physical inventory. The last two columns were used quarterly in checking the Book Inventory against the Physical Inventory. The Remarks Column was generally used for entering the requisition number of the material received because all procurement files were filed by requisition number for reference purposes and entering the requisition number on the Perpetual Inventory Card saved much time. The Remarks Column was also used for entering new unit costs. Identical items were purchased at different costs and this caused a change in unit price. These cards were ruled and totaled monthly for the purpose of submitting reports to the District Engineer. Every three months the cards were ruled and the total amount for the period was posted to the quarterly book and physical inventory report.

Form RA-GEN-93, Government Owned Equipment Card, recorded the type of machine, the number of the machine, the purchase date, the cost, estimated hours in service, and the rate of use depreciation. The body of the form was composed of five columns. Column one was for the period of service; column two was for the hours used during the period; column three was for the Cost of Usage amount. The Usage amount in this case is comparable to the depreciation amount. Column four was for total usage amount. In this column the accumulated total of all depreciation was carried. Column five was the Salvage Value of the pieces of equipment. One card was set up for each piece of equipment. On the back of this card were placed the purchase order number, the date received, the serial number, and former repairs done to the piece of equipment. It was necessary too, that a record of all repairs to passenger vehicles be kept, due to the fact that the Procurement Office required very detailed data prior to their authorization of repairs needed. In many instances repairs were held up over a period of weeks until this data could be secured. Especially was this true on transferred equipment.

Receipts of material were posted to Form RA-GEN-65, Perpetual Inventory Card, from Form A-8, Receiving and Inspection Report; Form RA-GEN-77, Transfer of Material

Supplies and Equipment from Other Projects and Divisions; Form RA-BM-9, Requisition for Supplies, Equipment, and Service; and Form RA-BM-50, Invoice and Receipt. These were the original receiving documents. After posting the day's receipts to the Inventory Cards from one or all of these forms, the inventory clerk would take a total both of the receipts entered on the card and of the receipts that were on the various forms. If the two were in balance, the total was posted to a daily material control sheet.

Deliveries of material were made on Forms RA-GEN-61, Material Delivery Tickets, and Form RA-GEN-77, Transfer of Material and Supplies and Equipment to Other Projects and Divisions. Form RA-GEN-77 was used only in instances when material was being transferred to another project. Form RA-GEN-61 was turned in daily in some instances and semi-monthly in others. Tickets were turned in daily when raw material was being delivered direct to the field for use. Tickets were turned in semi-monthly in all precutting of materials where a daily tally sheet was kept on all raw material being used in the job plant as per production order. At the end of the semi-monthly period, which closed on the thirteenth and the twenty-eighth of each month, these tally sheets were totaled, material delivery tickets were written for the consolidated quantities of the materials used and turned in to the inventory clerk. The supporting tally sheet was attached to the Material Delivery Ticket. Only one Material Delivery Ticket was written for each yard order for the period, except in the cases of yard order #13 and yard order #10, which called for the pre-cutting and pre-fabrication of all material required for three and two bedroom houses. Since this work was carried on in several sections of the yard, it was necessary to have more than one consolidated delivery ticket turned in each period. Spot checks were made by the inventory clerk to determine whether or not the tally sheet checked with the delivery ticket. If it did not, the material checker who turned in the delivery ticket was called in and requested to straighten out his errors.

The material clerk priced each item listed on each material delivery ticket, posted from the delivery ticket to the Perpetual Inventory Card in the issued column and after posting to each card, he up-ended the card in the inventory box. After completing all the posting for the day, he totaled all the issues as shown on the cards to which he has posted. He then totaled the issues as shown on the delivery tickets. When these totals coincided, he posted the total amount of issues to the Daily Control

Sheet for material.

On each delivery ticket was the production order number to which the material was charged. After the inventory clerk had completed his posting from the material delivery tickets he turned the delivery tickets over to the cost clerk who would post the total amounts of charges against each individual production order to his cost sheets.

When material was returned from the field to inventory, Form RA-GEN-160, Inventory Return Ticket, was used. On this form the item of material, its quantity and price, and the production order to be credited were listed. The inventory clerk posted this credit (red entry) in the issued column of the Perpetual Inventory Card and in the issued column of the Daily Control Sheet for material. After completing his posting, he gave the return ticket to the cost clerk who posted the total amount as a credit to the production order involved.

In the case of transfer of material to another project, one copy of Form RA-GEN-77, Transfer of Material, Supplies and Equipment to Another Project, was used as a posting medium in precisely the same manner as a material delivery ticket, and was also turned over to the cost clerk who posted the total amount to the account, Transfers to other Projects and Divisions.

Form RA-GEN-93, Government Owned Equipment Record, was used to record all motorized and mechanized equipment. A card was set up for each piece of equipment as it was received. The basis for setting up this card was Form A-8, Receiving and Inspection Report, on which equipment received by the purchase of the Procurement Office was reported. Form RA-GEN-77, Transfer of Material, Supplies and Equipment from other Project; and Form RA-BM-50, Invoice and Receipt for Equipment received from Other Projects. From these forms the inventory clerk posted the name, description, and cost of the piece of equipment received. He also posted the total amount of equipment received during one day's business to a Daily Control Sheet for motorized and mechanized equipment.

The rate per hour of service was set up for each piece of equipment. Form RA-GEN-92, Equipment Time Ticket was turned in daily by the operator of each piece of equipment. The date, description of the equipment, machine number, the usage rate, the number of hours, the cost of the depreciation per day, and the production order number and description of the work for which the equipment was used was given on

this ticket. These equipment tickets were checked by the head timekeeper against the Form RA-CN-50, Daily Time Distribution Ticket for the operator's name and to see if his labor was charged against the same production orders as was the equipment. The tickets were then turned over to a cost clerk who posted the amount to the production order to which the equipment was charged. He also kept a sheet listing each type and piece of equipment in use, and to this he posted the number of hours used for that day for the specific piece of equipment. At the end of the period the equipment columns of the production order cost sheets were totaled. The Master Time Sheet for equipment hours was totaled. After being balanced, the amount of hours and depreciation for each piece of equipment was posted to Form RA-GEN-93, Government Owned Equipment Record, from the Master Time Sheet for equipment. The total amount of usage for the period was posted to the Daily Control Sheet for equipment in the Issued column. For the preparation of monthly reports these cards were ruled and totaled on the fifteenth of each month.

Construction Supplies Inventory consisted of articles used in the construction of the project which could not be charged to one specific account. Examples of construction supplies are gasoline, hand tools of all kinds, repairs to automobiles and other equipment, First Aid supplies, etc. These supplies were received in the same manner as were the materials. They were charged out into the construction accounts immediately upon receipt. Form RA-GEN-61, Material Delivery Ticket, was used for the delivering document. As with the materials, the total receipts and deliveries for each day's business were posted to the Daily Control Sheet.

All non-expendable property charged to construction, which consists principally of hand tools, were charged to the construction of the job immediately upon receipt of same. To maintain an account of these non-expendable items, it was necessary to erect a sub-inventory in which these items were held. As with the material and construction supplies, the record of these articles was maintained, on Form RA-GEN-65, Perpetual Inventory Cards. However, in receiving these items on this non-expendable property inventory, Form RA-GEN-61 was used rather than Forms A-8 or RA-GEN-77 and RA-BM-50, which was used as a receiving document on the material and construction supplies inventory. In fact, the same material delivery ticket which was used to deliver the non-expendable items from the construction supplies inventory was also used in posting to the non-expendable property inventory as a receiving document. At

the end of the job, Form RA-GEN-160, Inventory Return Ticket, was used in clearing this inventory. This ticket was posted in the Issued column of the non-expendable property inventory as a credit to issues and was posted to the issued column of the Construction Supplies Inventory in red as a debit to issues. A Daily Control Sheet was maintained for non-expendable property.

Office equipment and supplies were received on the same document as the material. As with construction supplies, all office equipment and supplies received were charged out immediately on Form RA-GEN-61, Material Delivery Ticket. This equipment and these supplies were charged into the "100" account as Construction Overhead. At the end of the job all the non-expendable property was taken back into inventory on Form RA-GEN-160, and a credit was made to the "100" account. Since most of the office equipment was received on Form RA-BM-50, Invoice and Receipt, at no charge to the project, very little cost was incurred. As with the other inventories, a Daily Control Sheet to which receipts and issues were posted was kept.

Form RA-GEN-65, Perpetual Inventory Card, was used to record all articles in job plant inventory. This inventory consisted of completed articles which were manufactured upon authority of yard orders issued by the Construction Engineer. The cost of manufacturing these articles was kept daily on Form FSA-CN-80, Production Order Cost Sheet. The daily costs were taken on Form RA-CN-50, Daily Time Distribution Ticket; Form RA-Gen-61, Material Delivery Ticket; and Form RA-GEN-92, Equipment Time Ticket. Each yard order lasted for the period from the sixteenth (16th) of the month to the fifteenth (15th) of the following month. This was necessary due to the fact that cost procedure called for production orders to last approximately only thirty days in order that costs of completed yard production orders be submitted to the District Engineer monthly. For example: The Construction Engineer issued a yard order calling for the precutting and prefabrication of ninety-three (93) barns. A daily cost was accumulated against this yard order for a period of thirty days. A daily quantity completed for each day was reported on Form RA-CN-50, Daily Time Distribution Ticket, and posted to the Production Order costs, and at the end of the cost period the Production Order Cost Sheets were totaled. For a double check, a physical inventory was taken to determine the quantity of pre-cut and pre-fabricated barns still in inventory. To determine the amount manufactured during that cost period the following procedure was used: The

balance on hand at the end of the period was determined by the physical inventory plus the number of barns delivered during the period, less the number of barns that were on hand at the beginning of the period. The yard order being completed, the Production Order Cost Sheet was used as a posting medium to the receiving column of Form RA-GEN-65, Job Plant Inventory, in order to place the completed pre-cut and pre-fabricated barns in the Job Plant Inventory.

On the Inventory Card was placed the full description of the article, the total quantity, the total amount, the date, the production order number, and the unit cost per completed item. The total of all amounts entered into the Job Plant Inventory for one day was brought to the Receipts column of the Daily Control Sheet. The amount of the completed yard order was posted as a credit to the Job Plant account of Form RA-CN-51, Monthly Report of Job Plant Production Costs, and as a credit to Job Plant Inventory account on the same form. This form was used in reporting monthly job plant costs to the District Engineer. A full description of its use will be taken up under Job Plant Accounting Cost Analysis section of this report. The Delivery of job plant materials to the field was accomplished by use of Form RA-GEN-61, Material Delivery Ticket. This was handled in precisely the same manner as were deliveries to the field for raw materials.

Storage inventory was kept on Form RA-GEN-65. The documents used in setting up this inventory were forms RA-GEN-77, Tools, Material, and Equipment Transfers, and RA-BM-50, Invoice and Receipt. In this inventory were kept records of materials, supplies, and equipment received from other projects and divisions which were <u>not</u> to be used at the Southeast Missouri Farms Project. As transfers were received, a check was made to determine what materials, supplies, and equipment were to be used and which were to be placed in storage inventory. After this was determined the original transfer was split, one transfer contained materials for use and was posted to the general inventory. The transfer containing material supplies and equipment for storage was posted to the storage inventory. The storage inventory was kept in divisions by projects. All materials held in storage for Central Minnesota Farms Project composed one section; material, supplies, and equipment held in storage for Osage Farms composed another section; material supplies and equipment held in storage for Oklahoma Farm Tenants' Program composed another section, etc. There were approximately ten sections

to the inventory. Often it was found possible to use material, supplies, and equipment that were being held in storage. When this was done, Forms RA-GEN-77, Tool, Equipment, and Material Transfers were prepared delivering all materials from the project for which it was held in storage to the Southeast Missouri Farms Project. On the body of the transfer was placed a quotation: "Materials transferred from storage inventory to general inventory". This transfer was used as a delivering document from the storage inventory and was posted to the issued column of the Perpetual Inventory cards of the storage inventory. It was also used as a receiving document in the general inventory and posted to the receipts column in this inventory. The transfer was then forwarded to the District Engineer's Cost Analysis Section. The daily control was maintained for the storage inventory as for the material inventory. The totals for each day's business were posted to the receipts or issued column of the Daily Control Sheet.

There were several reports which were sent in on certain periods for property accountability. These reports were as follows: Form RA-GEN-67, Perpetual Inventory, Dollars and Cents Report for Materials, Construction Supplies, Equipment, Office Supplies and Equipment, Non-Expendable Property Charged to Construction, Job Plant Inventory, Materials, Supplies and Equipment Held in Storage for Other Projects; Form RA-BM-49, Monthly Inventory Report for Motorized and Mechanized Equipment; Form RA-BM-49, Quarterly Inventory Report for Office Supplies and Equipment; Quarterly Book and Physical Inventory Report; and report for the expenses on passenger carrying vehicles for the current fiscal year.

Form RA-GEN-67, Dollars and Cents Inventory Report, was prepared as follows: This report covered the cost period from the 16th of the current month to the 15th of the following month. A separate form was submitted for each section of the inventory, one for materials, one for construction supplies, etc. This report contained the total cost of materials on hand before beginning of the period, the totals of materials, supplies, and equipment received during the period, the total cost issued to construction during the period, and the balance on hand at the end of the period. To secure this cost the daily control sheet was used. The daily control sheet for each section of the inventory recorded each total day's business for each section of the inventory, double checked before the totals were posted to the daily control sheet. At the end of the cost period

each control sheet was totaled, and a summary of the month's business was shown. The totals of the daily control sheet were transposed to Form RA-GEN-67 and typewritten in the original and three copies. The original and one copy was sent to the District Engineer with the Cost Reports, one copy was sent to the area engineer and one copy was retained for the project cost files. The total issues as shown on the dollars and cents inventory report must coincide with the total materials charged to construction on the monthly cost reports, or the month's business had to be audited before the reports were submitted.

The Quarterly Book and Physical Inventory Report was submitted every three months. This included cost periods for three months. On this report was listed each item of material, supplies, and equipment held in inventory. Column one contained detailed description of the articles of materials, supplies, and equipment. Column two was for "On hand at the beginning of the period". This Column was divided into two parts. Part one was for quantities of material, part two for cost. Column three was for material, supplies, and equipment received during the period. This column was also divided into quantities and costs. Column four was for materials delivered to construction during the period. This column was also divided into quantities and costs. Column five was for materials, supplies, and equipment returned to inventory during the period. Column six was for the balance of the book inventory on hand at the end of the period. Column seven was for the physical inventory at the end of the period. Column eight was for the difference between the physical and book inventory. Column nine was for the adjustment form and number. At the end of each quarter each inventory card was ruled and totaled. From these cards were posted the quarterly totals to the inventory report form. The totals, as posted from the cards, completed columns two to six inclusive. From column seven, physical invnetory column, a physical inventory was taken and priced. The items taken on the physical inventory were posted opposite the corresponding item that had been on the book inventory. The quantities taken from the physical inventory were priced according to the unit cost of the material as held on book inventory. Naturally there was some difference between the book and the physical inventory at the end of the period. This difference between the physical and book inventory was posted in column eight. To adjust the differences, Standard Form 1017-G, Journal Voucher, was used. This adjusting form was sent in to the District Engineer with this report, and when it was approved by the District Engineer it was

posted to the Perpetual Inventory Cards as an adjustment. In this manner the book inventory was adjusted to conform with the physical inventory each three months. It was necessary for the totals of the quarterly book and physical inventory report to coincide with the totals for the three months' period as reported on Form RA-GEN-67, Monthly Dollars and Cents Inventory Report.

Form RA-BM-49, Monthly Inventory Report for Motorized and Mechanized Equipment, was submitted to the Business Management Office of the Farm Security Administration, Indianapolis, Indiana, listing each piece of motorized and mechanized equipment with description, motor number, serial number and FSA number or license number.

Form RA-BM-49, Quarterly Inventory Report for Office Supplies and Equipment, was submitted to Business Management section of the Farm Security Administration, Indianapolis, listing all office equipment classified as "A" or "B" equipment. The "A" equipment consisted of desks, typewriters, file cabinets, etc. The "B" equipment consisted of stapling machines, rulers, and various other inexpensive office equipment. Each item was listed with the identifying number on this report.

It was necessary for the project to submit every six months a list of all expenditures made for the repairs of each individual passenger carrying vehicle for the preceding fiscal year. This was submitted to the Business Management Section of the Farm Security Administration, Indianapolis, Indiana.

PLATE 306

The basis for the system of Cost Analysis set up for Southeast Missouri Farms Project was the Production Order. There were three types of Production Orders: Yard Orders, Field Orders, and Special Orders. All costs were kept by Production Orders. Cost on overhead accounts were also kept on Production Order Cost Sheets.

Production Orders were issued to cover all Job Plant Operations, called Yard Orders. There were fifteen general yard orders issued during the course of the project. It was necessary that the Yard Orders be totaled each cost period and posted to Job Plant Inventory. (See Job Plant Inventory under Property Control.) On Yard Order No. 2, for instance, it was necessary to report the period February 16th to March 15th as Production Order 2a; for the

period March 16th to April 15th as 2b, etc. Therefore over a four month period the project had a total of approximately sixty (60) period Yard Orders.

General Orders were broken down into many sub-orders, in order to determine quantities completed during a period. For instance, Yard Order 13 has eleven (11) sub-orders. It was necessary to keep a percentage ratio of each sub-order to the general order to determine how many houses had been precut and prefabricated. If panels for ten (10) houses, trusses and nailers for twelve (12) houses, frames for fifteen (15) houses etc., had been made during the period, each of these items had a flexible percentage ratio to the general order and from this a total of a specific number of houses was figured. Needless to say, the figure of completed homes was not precisely correct, but there was no other method that could bring a more accurate figure in time to be of use for construction purposes.

Yard Orders were distributed to the Yard Superintendent, the Cost Section, and the Material Clerk. Each order contained quantity to be produced, specifications, schedule of production, etc. The Yard Timekeeper kept a daily record of the labor costs in relation to the quantity of work completed each day, using care due to the fact that one man, at times, would work for four or more Yard Orders in one day. The cost distribution and quantities completed as shown on the Daily Time Distribution Tickets were posted to Form RA-GEN-56, Semi-Monthly Consolidated Sheet - Production Time and Form RA-CN-80, Production Order Cost Sheet.

Equipment Cost Distribution was secured from Form RA-GEN-92 and was posted daily to RA-GEN-74, Semi-Monthly Consolidation Sheet - Cost Owned Equipment, and Form FSA-CN-80, Production Order Cost Sheet;.

Tally sheets were used in accumulating the quantity of materials used on Yard Orders during bi-monthly periods. Material checkers kept a daily record of material used each day for each Yard Order. These were consolidated each fifteen (15) days and a Material Delivery Ticket, Form RA-GEN-61, was prepared. The tally sheets were attached to this form and turned in to the Inventory Clerk. Spot checks were made on the tally sheet to determine if the consolidation was correct. After the Inventory Clerk had posted the withdrawals from the main inventory, the RA-GEN 61 was then given to a cost clerk who posted the ticket to the Form FSA-CN-80, Production Order Cost Sheet

and Form RA-GEN-57, Semi-Monthly Consolidation Sheet - Materials.

The cumulative information taken from Form RA-CN-50, RA-GEN-92, and RA-GEN 61 was posted (daily in the first two instances and semi-monthly in the last instance) to the three semi-monthly consolidated sheets, Form RA-GEN-56, Semi-Monthly Consolidation Sheet - Production Time; Form RA-GEN 74, Semi-Monthly Consolidation Sheet - Cost owned Equipment; and Semi-Monthly Consolidation Sheet - Materials. This same information was accumulated on Form FSA-CN-80, Production Order Cost Sheet. The quantities completed daily were posted to both Form RA-GEN 53, Semi-Monthly Consolidation Sheet - Quantities Installed, and Form FSA-CN-80

This form was a combination of the Forms RA-GEN 53, 56, 57, and 74. While the labor, quantities, material cost, and equipment cost was being accumulated individually on the four forms, these costs and quantities were also being accumulated on the FSA-CN-80.

Form FSA-CN-80, Production Order Cost Sheet reflected the Yard Order number, the date of issue, the name of the issuing officer and the date the order was completed at the Job Plant. In addition there were ten (10) columns which were used in the following manner:

Column one (1) contained a description of the item to be produced. In column two (2) was posted the date of entry. In column three (3) was posted from RA-CN-50 the daily labor cost, incurred against the Yard Order each day. In column four (4) was posted from RA-GEN 61 - Material Delivery Ticket, the cost of the raw materials incurred. Column five (5) was posted to from RA-GEN 92, Equipment Time Ticket. Column six (6) consisted of the accumulated daily total of columns three, four and five. Column seven (7) consisted of the "total to date" of columns three,four and five. In column eight (8) was posted the daily quantities completed, taken from RA-CN-50. Column nine (9) consisted of the unit cost per completed item. Each of these columns listed were totaled for total cumulative costs of labor material, equipment, and quantities produced.

When the Production Order was completed, the total cost and quantity was posted as a receipt to Form RA-GEN 65, Perpetual Inventory Record Card showing the total cost, unit cost, and quantity of articles produced under the

Production Orders.

The totals of the completed Production Order were also posted to the Form FSA-CN-51, Monthly Report of Job Plant Costs as a credit. This form was used in reporting the Job Plant Production Costs to the District Engineer's Cost Analysis Section.

This form reflected the certification of the preparing officer and the approving officer, the Project name and number, and the report period. The main body consisted of eleven (11) columns. Columns one and two contained the Production Order number and name· column three was for labor. The totals for the month were posted to this column from form RA-GEN 56, semi-monthly consolidation sheet for Production Time. Column four was for raw material. The totals of Form RA-GEN 57 were posted to this column. Column five was for equipment cost. The monthly totals were posted to this column from form RA-GEN 74, Semi-Monthly Consolidation Sheet for Equipment Costs. Column six (6) was for Total Production Costs. This represented the total of column three, four, and five. Column seven (7) contained Total Materials Produced. This column was posted to from Form RA-GEN 53, Semi-Monthly consolidation sheets for Quantities Installed. Column eight (8) was for the unit of measure. Column nine (9) was for the unit cost which was taken from the completed Production Order Cost Sheet. Column six (6) represented a debit to the Job Plant Account. This was the total cost of all work done in the Job Plant for one period. Column ten (10) was for the total credit to the Job Plant. To this column was posted the total of the completed Production Order. When the total of column six (6) exceeded that of column ten (10) the difference represented the amount of work in process on incomplete Production Orders. However, this case occurred very seldom as practically all period Yard Orders were totaled at the end of each cost period and were considered complete. Column eleven (11) was for the debit to Job Plant Inventory. This was to show that the completed Production Order was posted to the Job Plant Inventory. Column ten (10) was always equal to column eleven.

The completed Production Order being posted to the Job Plant Inventory, the finished articles were ready for delivery to the field. These deliveries were accomplished by the use of RA-GEN 61, Material Delivery Ticket.

PLATE 307

The basis of cost accounting for field production was the Field Production Order. These orders were issued by the Construction Engineer in advance of work to be done. Costs were accumulated on Form CN-80 Production Order Cost Sheet and Forms RA-GEN 53, Semi-Monthly Consolidated Sheet for Quantities Completed, Form RA-Gen 56, Semi-Monthly Consolidated Sheet for Productive Time, Form RA-GEN 57, Semi-Monthly Consolidated Sheet for Materials, and Form RA-Gen 74, Semi-Monthly Consolidated Sheet for Equipment Costs. There were two divisions for the accounting of field costs.

Division one was kept on Form FSA-CN-80, Production Order Cost Sheet. This sheet was maintained for each individual field production order. There were approximately thirty-six (36) general field production orders issued, fifteen (15) special orders which were charged to the field production and approximately fifteen (15) overhead and final construction expense accounts which were maintained on Form CN-80 under field production costs.

Costs were accumulated on Form CN-80 in the same manner as described under Job Plant Production. Besides keeping costs by field production order number, costs were also kept by account numbers as set up by the District Engineer's Cost Analysis Section. Account number five (5) was for surveys, account number ten (10) was for Land Development, account number twenty (20) was for Road and Street Construction, account number forty (40) was for Wells. Account number eighty (80) was for Fencing. Account number ninety (90) A was for Two-Bedroom Houses. Account number ninety (90) B was for Three-Bedroom Houses, and account number ninety (90) C was for Barns. Account number ninety (90) D was for Privies; account number ninety (90) E for Food Storage Buildings. Account number ninety (90) F was for the new Cooperative Store Building. Account number ninety (90) G was for the Blacksmith Shop. Account number one hundred (100) was for Construction Overhead. This account was broken down to show non-appointive clerical salaries, appointive clerical salaries, non-appointive watchmen and guards, heat and light, appointive salaries for supervision and construction, transportation within the project, etc. Account number two hundred (200) was for General Construction Expense. This account was broken down into temporary construction, hand tools, power tools, equipment and maintenance, delivery and handling of materials, warehouse operation, first aid service, and loss by fire. The loss of material in the fire of May 8th was taken into account

under general construction expense. Account number three hundred (300) was for Charges to Other Projects and/or Divisions. Transfers to other projects and divisions were posted against this account number. There was a sub-account for the total costs of material transferred to one project, one for the cost which the receiving project placed upon the transfer material, and one for the amount of loss from the transferred value to the transferred receipts. Account number four hundred (400) was for Office Site Costs. These costs were kept by the Washington office. Account number nine hundred (900) was for Option Unit Costs. All repair work was listed by unit number under this account and costs were kept accordingly.

The costs by account number accumulated on Forms RA-GEN 53, 56, 57 and 74, and from Forms FSA-CN-50, RA-GEN 61 and RA-GEN 92 in the same manner as production order costs. Each period the totals as accumulated on Field Production Orders balanced with the totals accumulated by account number. The Field Production Order Costs were kept primarily for project cost information. The costs by account numbers were kept primarily for the Washington office. The prefabricated materials that were accumulated on Job Plant Inventory from Yard Production orders were charged from the inventory into the material column of Forms RA-CN-80, Production Order Cost Sheet of Field Production Orders. The prefabricated materials were also charged on the Form RA-GEN 57, Consolidated Sheet for Materials by kinds of improvement. Raw material costs were accumulated daily on the Production Order Cost Sheets and the Material Consolidated Sheets. The daily costs were taken from Material Delivery Tickets.

Daily Field Labor Costs were posted daily to Form RA-GEN-56, Productive Time Consolidated Sheets and Form FSA-CN-80, Field Production Order Cost Sheets from RA-CN-50, Daily Time Distribution Sheets.

Daily Quantities Installed were posted to Form RA-GEN 53, Consolidation Sheet for Quantities Installed, and Form RA-CN-80, Field Production Order Cost Sheet.

Equipment Depreciation was posted daily to Form RA-GEN 74, Consolidated Sheet for Government-Owned Equipment. Straight line depreciation was used on an hourly basis. The posting medium in this case was Form RA-GEN 92, Equipment Time Ticket.

Monthly cost reports to the District Engineer consisted of

the following forms: Form FSA-CN-51, Monthly Job Plant Production Costs; Form RA-GEN 126, Monthly Report of Consolidated Costs by Kinds of Improvement; Form RA-GEN 67, Dollar and Cents Inventory Report for Materials, Supplies, Equipment, Office Supplies and Equipment, Job Plant Inventory, Non-expendable Property charged to Construction, Materials, and Supplies and Equipment Held in Storage for Other Projects and Divisions: Form FSA-CN-80, Production Order Cost Sheets for completed production orders, Monthly Recapitulation Cost Distribution and Monthly Summary of Costs.

One Form RA-GEN 126 was submitted for each account, as, Land Preparation; Road and Street Construction; Water Supply Systems; Fencing; etc. In the right-hand corner of this form is placed the Project name, report period, and the account name and number. Column 1 is for account number; column 2 was for construction item, which consisted of the account description; column 3 was for unit of measure; column 4 was for quantities installed during the period; column 5 was for productive time; column 6, non-productive time, column 7, total labor; column 8, material; column 9, equipment, column 10, total labor, material, and equipment, column 11, unit cost of productive labor; column 12, unit cost of material and equipment.

Figures for columns 3 and 4, unit of measure and quantities installed, were obtained from the Form RA-GEN 53, Consolidation Sheets for Quantities Installed during the Period. Figures for columns 5, 6, and 7, labor costs, were taken from the totals of Forms RA-Gen 56, Consolidated Sheets for Productive Time. Figures for column 8, material, were taken from Form RA-GEN 57, Consolidation sheets for Materials. Figures for column 9, equipment, were taken from Form RA-GEN 74, Consolidation Sheets for Government-Owned Equipment. Column 10 was the total of columns 7 plus 8 plus 9. Column 11, unit cost of productive labor was column 7 divided by column 4. Column 12, unit cost of material and equipment, was columns 8 plus 9 divided by column 4. The summary of this form represented all field costs by monthly periods.

"Recapitulation of Cost Distribution" was the summary of the monthly costs as reported on Forms RA-GEN 126, Monthly Field Report of Consolidated Costs by Kind of Improvement, and FSA-CN-51, Monthly Job Plant Production Costs. The "Summary of Costs" was prepared by taking total payrolls plus total materials charged to construction from the perpetual inventory cards plus 1034 vouchers. The total of the Summary of Costs and the total of the Recapitulation Cost Distribution had to balance. All costs charged to

construction during a period must balance with the total payrolls, inventory charges, and other cost vouchers making up the expenditures for the period.

Cost reports were sent to the District Engineer in the original and one copy. One copy was also sent to the Area Engineer's Office in Indianapolis. The District Engineer's Cost Analysis Section accumulated these costs on special ledger sheets, one copy of which they sent to the project two or three weeks from the time the report had been sent in.

Maintaining the job plant production costs and the field production costs accurately required care. The Job Plant manufactured articles to be used in the Field; the Field took these articles and incorporated them into the final buildings. When the job was completed, all job plant costs had been charged as material into the field production costs.

CONCLUSION

The design and construction of the Southeast Missouri house has received a considerable amount of publicity as an outstanding example of low-cost housing. It would be more nearly correct to regard it as low-cost farmstead construction.

The most important conclusions to this report are the costs.

Plates 305, 306 and 307 show in graphic form the administrative mechanism employed to secure accurate cost data on those operations.

Plates 308, 309, 310, 311, 312 and 313 are samples of a monthly period report as actually submitted from the field for the period.

Plates 314, 315, 316, 317, 318, 319, and 320 not only show the complete audited cost of the operations but give an analytical cost and operating breakdown of the major division of the work as actually scheduled and performed.

The total average cost of each major item of farmstead construction is as follows:

Wells -	$ 24.24
Barnyard Fencing -	71.36
2-Bedroom Houses -	929.50
3-Bedroom Houses -	1105.27
Barns -	481.28
Privy -	41.90
Food Storage -	142.94

It will be noted by anyone studying Plate 316 from which the above costs are taken that the item, (H), Indirect Cost, Supervision and Overhead amounts to $7057.35, has not been distributed as a burden to the direct costs.

This item represents charges paid by the construction activities but actually performed for non-construction purposes, such as work for the management division, transportation (moving families, furniture, etc.), materials and equipment supplied and operated for other than construction activities. Such charges would never occur in

any building operation or if they did occur would be paid for separately and cannot be included in direct construction costs.

There are a number of specific conclusions which the District Engineer and his staff have drawn from their experience in this particular operation.

First, we believe that the design, construction and all engineering services for any given operation must be under one executive and administrative control and direction.

PLATE 321

Second, we believe that all low-cost design, construction and services must be worked out complete for each separate problem in accordance with a well-defined plan developed on the ground to meet that particular problem.

PLATE 322

The three major cost items are: (1) material costs, (2) construction costs and (3) overhead costs. For any given structure there is a fixed quantity of materials. Variation in cost is therefore only a factor of quality of materials and the possibility of savings due to quantity buying, economies in storage, transportation and handling. These economies are a matter of ability and experience. For low-cost housing, good quality of materials is essential.

PLATE 323

Coordination of design and method of construction to accomplish first, maximum usability of the finished structure and secondly, the greatest simplicity of construction methods, is the real secret of low-cost construction. Skill and experience of both labor and management make up a large element of this factor.

Overheads are necessary. Government overheads are always excessive. Non-Government overheads can easily become excessive if not carefully watched. Generally speaking, the minimum number of structures necessary for low-cost building is determined by this factor. The lowest workable overhead cost must be distributed over each structure. Skill, experience and careful planning are the essential elements of this factor.

PLATE 324

Third, we believe that all designs, plans and programs must be completed, studied, tested and adjusted before operations are begun. Each man charged with directive and administrative authority must be qualified for his particular functional job and he must know what each man associated with him is doing.

Fourth, we believe that low cost building can be accomplished only by satisfied, enthusiastic workmen, working on a safe, well organized job. Low pay, poor working conditions and impersonal direction will ruin an otherwise sound program.

The inquiries directed to the Farm Security Administration, the Director of Region Three, and the technical staff, who performed the construction operations at Southeast Missouri indicate a wide interest in this specific example of low-cost farmstead construction. This interest, however, is mainly concerned with what this operation offers as a solution to the problem of building labor homes - urban and rural - for that seventy percent of our families who need such housing; the families with incomes under two thousand dollars a year.

The District Engineer and his staff have taken this particular house as built at Southeast Missouri as a base. Messrs. Nedvid and Jones, the original architects who worked on this design, are now employed with the United States Housing Authority and Messrs. McGaughan and DeGree have completed the necessary architectural studies. This work was accomplished in close cooperation with Messrs. Layton, Halsey, Haywood, Cassell, Hansen and Kinkade, all experienced builders. Mr. Crouch, the District Engineer and Mr. Layton, the Superintendent of Operations at Southeast Missouri, have personally planned and directed all details of these studies.

PLATE 325

In Plate 325 we show a sketch rendering of this house built on a concrete slab foundation. In the tables of cost estimates we indicate the cost variations when this house is built on a pier foundation, a pier and curtain wall foundation, a concrete curtain wall and footing foundation, and a full basement.

In Plates 325 and 326 we show the first and second floor plan and an alternate first floor necessary when a basement is included.

In Plate 327 we show the section of the house as illustrated in Plate 325 and also another alternate first floor plan.

These sketches outline the general features of this house. For each class and phase of planned construction as outlined in the cost tables below, detailed drawings must be prepared, studied, analyzed, and adjusted to fit not only design and use requirements but coordinated in all details to the construction plan and program.

I	II	III	IV	V	VI	VII	VIII
Piers	Piers & Curtain Walls	Footings, Concrete Walls	Basement Concrete Walls	Basement Block Walls	Concrete Floor Slab	Water System Add.	Septic System Add.
TABLE "A" 2-BEDROOM (SOUTHERN TYPE)							
1540.00	1575.00	1690.00	1950.00	1920.00	1635.00	100.00	90.00
TABLE "B" 4-BEDROOM (SOUTHERN TYPE)							
1930.00	1955.00	2095.00	2355.00	2325.00	2085.00	100.00	90.00
TABLE "C" 2-BEDROOM (NORTHERN TYPE)							
1700.00	1725.00	1865.00	2125.00	2090.00	1810.00	200.00	100.00
TABLE "D" 4-BEDROOM (NORTHERN TYPE)							
2205.00	2230.00	2370.00	2630.00	2595.00	2315.00	300.00	100.00

PLATE 326

The report indicates the type and amount of work which we believe to be essential to develop these studies into a complete plan and program.

PLATE 327

We would not use the method of construction employed at Southeast Missouri unless there were special conditions warranting it. The method we will use combines some of the principles employed at Southeast Missouri with others used on the twenty odd construction projects completed by this staff in the twelve North Central States of this District. The overheads considered in these tables are not Governmental overheads, but do include a reasonable

construction profit.

In the above four tables we give the cost, including a reasonable construction overhead and profit for which we believe we can build these houses in the general locality indicated in each table.

These costs include a completely modernized house, wiring and fixtures, heating equipment, plumbing and bathroom equipment, kitchen cabinet, grading and screens. Each house is completely insulated for the climate in which it is to be built. There is, of course, a wide variation in interior finish. These houses are assumed to be a standard interior finish of good quality.

There are two very desirable alternates which have not been shown in this table. The 4-bedroom house, Southern type, Table "B", would often be built, but the upstairs would not be finished. A deduction can be made of approximately $375.00 from each house listed in Table "B" when this alternate is used. A similar alternate is possible and will be widely used for the 4-bedroom Northern type house, Table "D". Approximately $395.00 can be deducted from each estimate when the upstairs in these houses are not finished. By utilizing the "B" and "D" Type house in the initial construction activities, provisions are automatically made for a very cheap expansion of this house, as additional space is needed. This expansion can be performed at any time as the stairwell is utilized in the these alternates as a wall closet for a "roll-away" bed and auxiliary storage.

In each of the four tables we have estimated, in columns 7 and 8, the amount that should be added if the houses are built in areas where no water or sewer connections are possible and a pressure water system and septic system are necessary. These estimates will vary widely with each specific case.

In the tables below we have made certain assumptions to enable us to outline an approximate sale cost program for these houses. We have assumed that the land on which the house is built will cost $400. This is an average minimum improved 40-foot lot, or a larger tract of unimproved land, possessing the essential transportation, school, and shopping center facilities.

Table A	I	II	III	IV	V	VI
Construction -	1540.00	1575.00	1690.00	1950.00	1920.00	1635.00
Land -	400.00	400.00	400.00	400.00	400.00	400.00
Estimate Developm't.-	1940.00	1975.00	2090.00	2350.00	2320.00	2035.00
Profit and Expense -	260.00	275.00	310.00	350.00	330.00	265.00
Price	2200.00	2250.00	2400.00	2700.00	2650.00	2300.00
10% Down Payment -	220.00	225.00	240.00	270.00	265.00	230.00
90% Mortgage -	1980.00	2025.00	2160.00	2530.00	2385.00	2070.00
Approx. Monthly Carrying Cost -	22.00	22.50	24.00	27.00	26.50	23.00

(Est. at 1% Cost)

Table B	I	II	III	IV	V	VI
Construction -	1930.00	1955.00	2095.00	2355.00	2325.00	2085.00
Land -	400.00	400.00	400.00	400.00	400.00	400.00
Estimate Development-	2330.00	2355.00	2495.00	2755.00	2725.00	2485.00
Profit and Expense -	220.00	245.00	305.00	245.00	275.00	215.00
Price -	2550.00	2600.00	2800.00	3000.00	3000.00	2700.00
10% Down Payment -	255.00	260.00	280.00	300.00	300.00	270.00
90% Mortgage -	2295.00	2340.00	2520.00	2700.00	2700.00	2430.00
Approx. Monthly Carrying Cost -	25.50	26.00	28.00	30.00	30.00	27.00

(Est. at 1% Cost)

Table C	I	II	III	IV	V	VI
Construction -	1700.00	1725.00	1865.00	2125.00	2090.00	1810.00
Land -	400.00	400.00	400.00	400.00	400.00	400.00
Estimate Development-	2100.00	2125.00	2265.00	2525.00	2490.00	2210.00
Profit and Expense	200.00	200.00	235.00	275.00	210.00	190.00
Price -	2300.00	2325.00	2500.00	2800.00	2700.00	2400.00
10% Down Payment -	230.00	232.50	250.00	280.00	270.00	240.00
90% Mortgage -	2070.00	2092.50	2250.00	2520.00	2430.00	2160.00
Approx. Monthly Carrying Cost -	23.00	23.25	25.00	28.00	27.00	24.00

(Est. at 1% Cost)

Table D						
Construction -	2205.00	2230.00	2370.00	2630.00	2595.00	2315.00
Land -	400.00	400.00	400.00	400.00	400.00	400.00
Estimate Development-	2605.00	2630.00	2770.00	3030.00	2995.00	2715.00
Profit and Expense -	195.00	270.00	230.00	270.00	205.00	185.00
Price -	2800.00	2900.00	3000.00	3300.00	3200.00	2900.00
10% Down Payment -	280.00	290.00	300.00	330.00	320.00	290.00
90% Mortgage -	2520.00	2610.00	2700.00	2970.00	2880.00	2610.00
Approx. Monthly Carrying Cost -	28.00	29.00	30.00	33.00	32.00	29.00

(Est. at 1% Cost)

The construction costs from the previous tables are used for each class of building. A reasonable profit and expense for the developer of the project is allowed and the sale price indicated. A 10% down payment, based on this price; the amount of the 90% mortgage that would have to be insured and carried; and an approximate monthly carrying charge which includes the financing, insurance, heating, hot water, maintenance and depreciation, is shown. These monthly charges were computed by the much used "rule of thumb" of 1% of the sale price of the house. Monthly charges will be materially reduced with reduction in interest rates and increased or decreased depending on heating conditions, tax rates, etc.

The District Engineer of District III and his staff have completed the design and construction of approximately $22,000,000.00 worth of work during the past three years. The Southeast Missouri Project was the last one started and completed. On April 24, 1939, the District Engineer was informed that no funds will be made available for construction or land development work during the 1939-40 fiscal year.

The District Engineer and his senior staff members have not therefore been able to prove by actual experience and cost analysis the estimates given in this conclusion. It is evident that they will not have an opportunity to do so for the Farm Security Administration. It is also evident that within the very near future these men will be doing this type of work for other Governmental Agencies now currently engaged in this work, or for private enterprises.

They are convinced that they can produce a second Southeast Missouri Project materially improved as to use requirements and at least ten to twenty percent less cost under Governmental methods and at a considerably less amount without using such Governmental restrictions.

They are also convinced that they will build many of these labor homes for public or private interests at the costs outlined in this Conclusion.